Operating and Service Manual

BRUSH 440
RECORDER
ALL MODELS

MP MASTER
MA34597

GOULD

GOULD BRUSH

MANUAL PART NO.
15-806347-00

BRUSH 440
RECORDER
ALL MODELS

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TABLE OF CONTENTS

			page
I	GENERAL INFORMATION		
	1.1	Scope	1.1
	1.2	Introduction	1.1
	1.3	Specifications	1.3
II	INSTALLATION		
	2.1	General	2.1
	2.2	Incoming Inspection	2.1
	2.3	Power Requirements	2.1
	2.4	Signal Input Connections	2.1
	2.5	Portable Case Installation (Model 11-1113-00)	2.1
	2.6	External Chart Takeup Installation (Model 11-6402-05)	2.3
	2.7	One-Second Event Timer Installation (Model RA2101-10)	2.4
	2.8	Interchannel Event Marker Kit Installation (Model 11-6222-02)	2.5
	2.9	Overall Dimensions	2.6
III	OPERATION		
	3.1	General	3.1
	3.2	Front Panel Controls	3.2
	3.3	Back Panel Controls	3.3
	3.4	Recorder Set-up and Operation	3.3
IV	MAINTENANCE		
	4.1	General	4.1
	4.2	Changing Chart Paper	4.1
	4.3	Replacing Analog Pen	4.2
	4.4	Replacing Event Pen (Model 11-2873-20)	4.4
	4.5	Replacing Penmotor Band Asm	4.4
	4.6	Pen Pressure Measurement & Adjustment	4.6
	4.7	Pen Lapping	4.7
	4.8	Ink Cartridge Replacement	4.8
	4.9	Pen Cleaning	4.9
	4.10	Lapping Procedures for Extended Life Pen, Model 11-2823-34	4.10
	4.11	Inverting or Non-inverting Operation	4.10
	4.12	Schematics	4.11
V	THEORY OF OPERATION		
	5.1	General	5.1
	5.2	Detailed Description	5.1
VI	CALIBRATION		
	6.1	General	6.1
	6.2	Test Equipment Required	6.1
	6.3	Procedure	6.2
VII	PARTS IDENTIFICATION		
	7.1	General	7.1
A	APPENDIX – NSPI 1636 Modification		A.1

SECTION I

GENERAL INFORMATION

1.1 SCOPE

This technical manual contains specifications and instructions for operation and maintenance of the Brush 440 Recorder. It also contains descriptions of, and procedures for installation, inspection, troubleshooting, repair and servicing of the 440 and accessories.

1.2 INTRODUCTION

The Brush 440 Recorder (Figure 1-1), designed for maximum versatility at low cost, has four 40-mm analog channels (the Biomedical version can be equipped with two 40-mm and one 80-mm channel), two event markers and eight pushbutton controlled chart speeds. This rugged recorder is available in a portable case (as shown in Fig. 1-1), or in a mobile console (Figure 1-2). This recorder performs with unsurpassed reliability in the laboratory, classroom, or hospital; in factory environments or in field applications.

The pressurized ink system enables the pens to write dry, smudge-free traces. Disposable, plastic ink cartridges can be replaced in minutes. If power is lost or if chart paper runs out, the writing system stops immediately and ink is sucked from the pen tip back into the system. "Puddling" cannot occur.

The pen-position servo system, based on a frictionless transducer, assures extreme accuracy. Penmotor and transducer are fully enclosed and are immune to wear, time and dirt.

Two standard event markers can be manually actuated by pushbuttons on the control panel or electrically actuated through convenient terminals.

Mobile console, Model 11-1128-75 (Figure 1-2) provides laboratory quality features such as a durable, easy-to-clean Formica top as a work area, a large storage drawer for additional supplies, and an inclined, recessed, and completely enclosed frame for up to four Brush 4200 and 4307 series preamplifiers. An optional Input/Output panel (Figure 1-3) is available for monitoring or slaving several recorders together. The recorder is slide mounted to facilitate servicing.

The Brush 440 is available with two chart speed variations: 1.0, 5, 25, 125 mm/min and mm/sec; and 5, 10, 25, 50 mm/min and mm/sec. (see Specifications for specific model number)

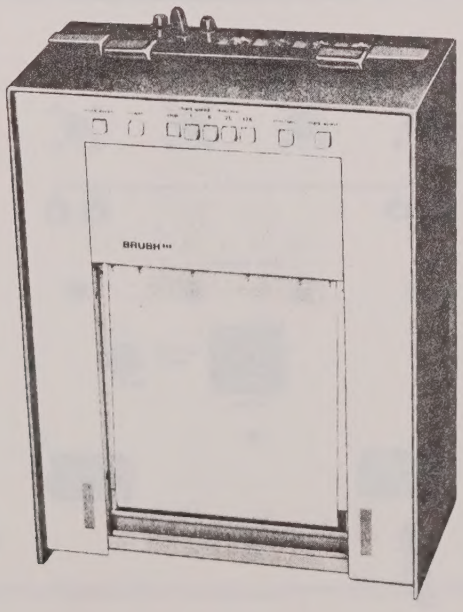


FIGURE 1-1 BRUSH 440 RECORDER

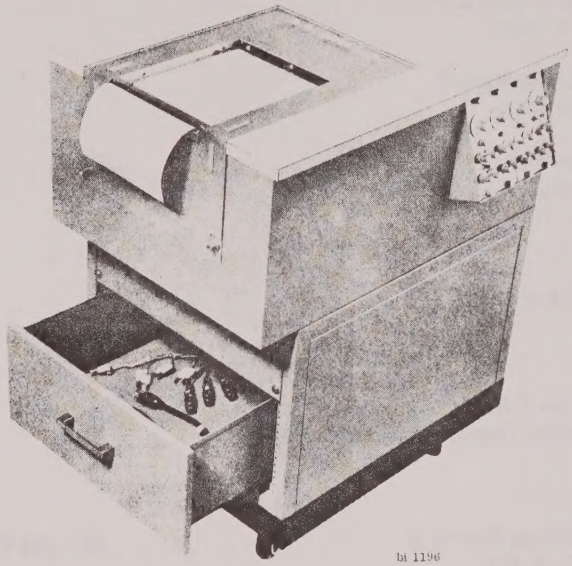


FIGURE 1-2 MOBILE CONSOLE MODEL 11-1128-75

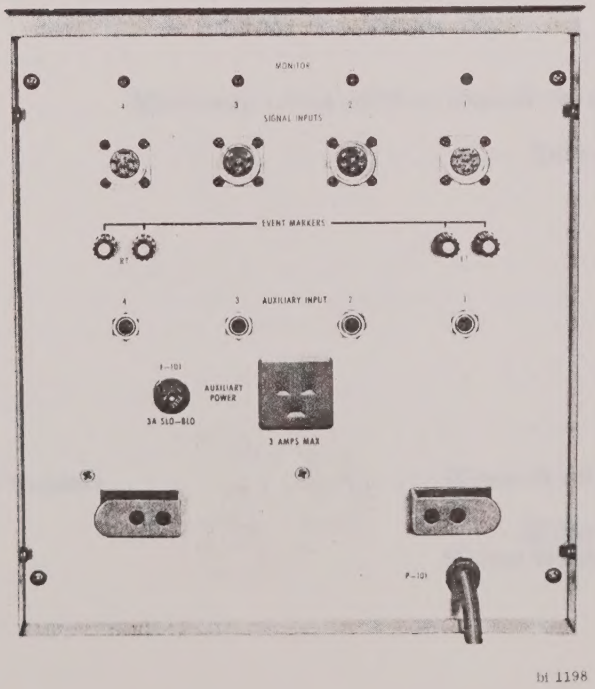


FIGURE 1-3 ACCESSORY INPUT/OUTPUT PANEL

1.3 SPECIFICATIONS

a. General

Number of Channels	4 analog and 2 event markers located on right and left margins (6347 series) 3 analog and 2 event markers located on right and left margins (6337 series)
Channel Span	40mm (50 divisions)(6347) series) 1–80mm; 2–40mm (50 divisions)(6337 series)
Trace Presentation	Rectilinear
Trace Width	0.01 in. nominal at 5 mm/sec chart speed
Marking Method	Pressurized marking fluid
Marking Fluid Capacity	Two 1-oz cartridges (sufficient for one year of normal recording); replaceable throwaway cartridge.
Chart Speeds	
Models 15-6347 & 15-6337-00, -05	8 speeds pushbutton (electrically) selected; 1.0, 5, 25, 125 mm/min and mm/sec
Models 15-6347 & 15-6337-10, -15	8 speeds pushbutton (electrically) selected; 5, 10, 25, 50 mm/min and mm/sec
Chart Speed Accuracy	±0.25%
Chart Length	High-contrast – 275 feet
Chart Width	7.9 inch.
Chart Divisions	50 divisons across width of channel (40 or 80 mm wide); 1 mm (time)
Rewind	External – see optional accessories

b. Electrical

Input Circuit	Single-ended, floating
Input Impedance	50K ohms
Input Sensitivity	100 mv/div, fixed
Deflection Non-Linearity	0.5% of full scale
Frequency Response (peak-to-peak)	40 mm Width: 50 divs ±1 div d-c to 40 Hz 10 divs ±1 div d-c to 100 Hz 10 divs ±1 div 3 dB down at 125 Hz 80 mm Width: 50 divs ±1 div d-c to 22 Hz 25 divs ±1 div d-c to 40 Hz 5 divs ±1 div d-c to 100 Hz

Stability, after 15 min warm-up (excluding paper drift)

- Zero with Time . . . . . ±0.1 div per 8 hours
- Zero with Temperature . . . . . ±0.1 div per °C at 25°C ±10°C
- Zero with Line Voltage . . . . . ±0.05 div per volt ±10% line variation
- Gain with Time . . . . . ±0.1% per 8 hours
- Gain with Temperature . . . . . ±0.05% per °C at 25°C ±0.0°C
- Gain with Line Voltage . . . . . .±0.05% per volt, ±10% line variation

Power Input . . . . . 115V a-c ±10%; 60 Hz, 175 watts, (275 va)

Operating Temperature . . . . . 0°C to 55°C

Storage Temperature . . . . . -40°C to 85°C

Dimensions . . . . . Refer to outline drawing 269815

Weight . . . . . .45 lbs (approximate)

1.5 SUPPLIES AND ACCESSORIES

Analog Pen 11-2823-33

Extended Life Analog Pen 11-2823-34

Event Marker Pen 11-2873-20

Ink Cartridge, Blue 11-2730-01

Chart Paper

- Hi-Contrast – 275 feet . . . . . 2200-2923-30 (6347 series)
- Hi-Contrast – 275 feet . . . . . 1200-2923-20 (6337 series)

Tools

NOTE: Those items supplies with original equipment are marked with asterisk.

- Pen Tubing Removal Tool 267528*
- Pen Replacement Wrench (Multiple splined) 1-120922-2*
- Pen Pressure Adjustment Wrench (Multiple splined) 1-120922-18*
- Gram Gage (Pen pressure) 240601-910*
- Band Replacement Tool 341409-915
- Band Replacement Wrench (Multiple splined) 1-120922-3
- Band Replacement Wrench (Hex) 245218-5

Portable Case Assembly	.11-1113-00
Mobile Console (Factory installed only)	.11-1128-75
External Chart Takeup	.11-6402-05
Interchannel Event Marker Kit	.11-6222-02
One Second Event Timer	RA2101-10
Analog Input Connector	.234321
Event Marker Connector	.269942

SECTION II

INSTALLATION

2.1 GENERAL

This section describes the inspection checks to be performed upon receipt of the Brush 440 and details power requirements and signal connections. This section also describes and illustrates installation of the Portable Case, Interchannel Event Markers, Mobile Console, and One Second Timer.

2.2 INCOMING INSPECTION

Perform the following procedures upon receipt of the unit.

1. Visually inspect unit for damage that may have occurred during shipment. Refer to warranty card in case of damage.

2. Remove packing material and tape from recorder.

NOTE: Do not attempt to operate this equipment before completing Section III, Operation.

2.3 POWER REQUIREMENTS

Listed below are the voltage, frequency, and power requirements for the various models of the Brush 440 Recorder.

Model No.	Power Source Requirements
15-6347-00	115 volts a-c ±10%; 60 Hz. 175 watts
15-6347-10	115 volts a-c ±10%; 60 Hz, 175 watts
15-6347-05	230 volts a-c ±10%; 50 Hz, 175 watts
15-6347-15	230 volts a-c ±10%; 50 Hz, 175 watts
15-6337-10	115 volts a-c ±10%; 60 Hz, 175 watts

2.4 SIGNAL INPUT CONNECTIONS

a. Analog

Inputs to analog channels should be made using a shielded two-conductor cable (Belden No. 8422 or equivalent). The input connectors (234321) are to be wired as follows:

High	Pin 1
Low	Pin 2 (Common)
Shield	Pin 3 (Chassis Gnd)

b. Event Marker

Event markers may be actuated by an external switch closure (short) across terminals located on rear panel. Connectors for these terminals are part number 269942.

Resistance of each event marker is 600 ohms at -32 volts d-c, connected from an internal source.

c. Mobile Console Input Panel

1. Analog (signal) input connections to the mobile console input panel should be made using 6 pin connector, Brush part number 244811. To properly wire these connectors, refer to individual preamplifier manual and table below:

6 pin (on panel)	8 Pin (on Preamplifier)
Pin 1 – connects to	Pin 4
Pin 2 – connects to	Pin 2
Pin 3 – connects to	Pin 6
Pin 4 – connects to	Pin 8
Pin 5 – connects to	Pin 7
Pin 6 – connects to	Pin 5
Shell (shield) – connects to	Pin 1

2. Event marker inputs are connected as described in Para. 2.4.b.

3. Monitor jacks are provided so that the preamplifier output may be monitored. These jacks are connected to output pin 15 of preamplifier. Mating connector is Brush part number 243270.

4. Auxiliary input jacks are provided so that any auxiliary high level (±2.5V d-c) can be connected directly into the Brush 440 Recorder, bypassing the preamplifier. Use Brush connector part number 114816-15.

   Connect signals as follows:

Tip	No connection
Ring	Signal Hi
Sleeve	Signal Ground

5. Input Panel schematic is 280385.

2.5 PORTABLE CASE INSTALLATION (Model 11-1113-00)

To provide greater ease of handling and portability in use, the Brush 440 Recorder may be mounted in a portable case, Model 11-1113-00. Refer to Figure 2-1 and proceed as follows.

1. Slide recorder into case, being sure that signal input panel is positioned for access thru hole in case.

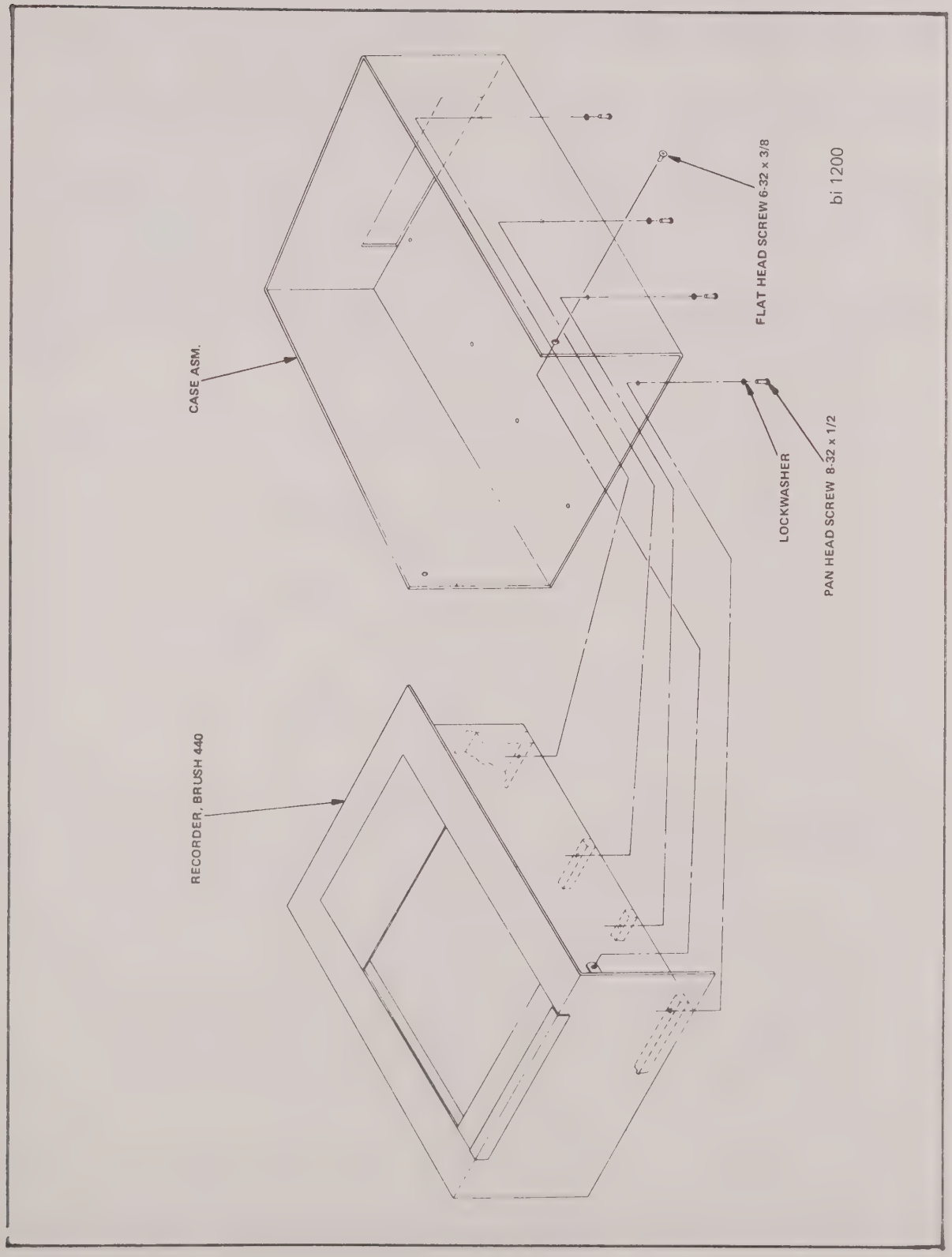


FIGURE 2-1 PORTABLE CASE INSTALLATION

2. Install eight 8-32 pan-head screws and lockwashers thru bottom of case into recorder. Do not tighten screws.

3. Install two 6-32 flat-head screws thru sides of case into recorder. Tighten all screws securely.

This completes portable case installation. For case removal, reverse above procedure.

2.6 EXTERNAL CHART TAKEUP INSTALLATION (Model 11-6402-05)

To install external chart takeup, Model 11-6402-05, refer to Figure 2-2 and proceed as follows:

1. If recorder is installed in portable case, Model 11-1113-00, remove recorder from case (refer to Para. 2.5).

2. If recorder is mounted in mobile console, Model 11-1128-75, extend recorder forward on slides.

3. Remove plastic protective caps covering slots on either top or front of recorder as required.

4. Slide pulley onto drive shaft and secure with cotter pin.

5. If takeup is to be front mounted, position takeup so that drive belt extends thru slotted hole.

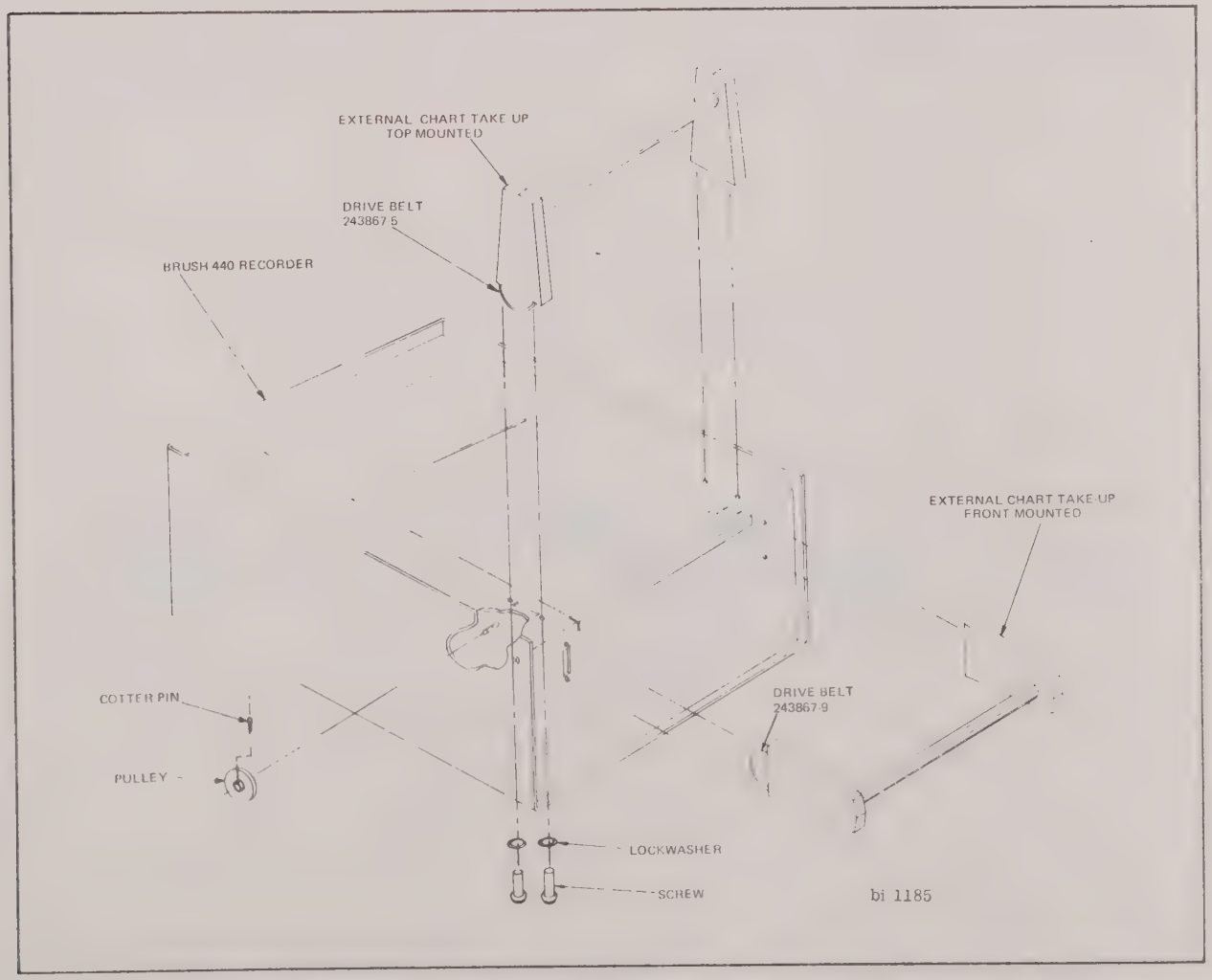


FIGURE 2-2 EXTERNAL TAKEUP INSTALLATION

6. Fasten both takeup arms using four 8-32 pan-head screws and four lockwashers.

7. Position takeup drive belt around pulley.

8. If takeup is to be top mounted, disassemble left takeup arm and remove drive belt.

9. Install new drive belt (Brush part number 243867-5) furnished with kit and assemble left drive arm.

10. Position takeup so that drive belt extends down thru slotted hole.

11. Fasten both takeup arms using four 8-32 pan-head screws and four lockwashers.

12. Position takeup drive belt around pulley.

13. Install recorder in portable case or slide unit into mobile console, as required. For installation instructions for portable case refer to Paragraph 2.5.

2.7 ONE-SECOND EVENT TIMER INSTALLATION (Model RA2101-10)

To provide accurate one second timing marks along with normal analog signal, a one second timer, model RA2101-10 can be installed to operate either the standard right event margin event marker or the right mid-channel event marker. Refer to Figure 2-3 and proceed as follows:

1. Remove recorder from portable case or mobile console. Unit must be completely exposed to aid in the installation of this timer.

2. Prepare one orange wire and one gray wire by attaching a quick-disconnect terminal lug (four lugs furnished with timer).

3. On recorder right side plate, locate timer mounting holes. Be sure two standoffs, screws, and hex nuts are installed in proper mounting holes.

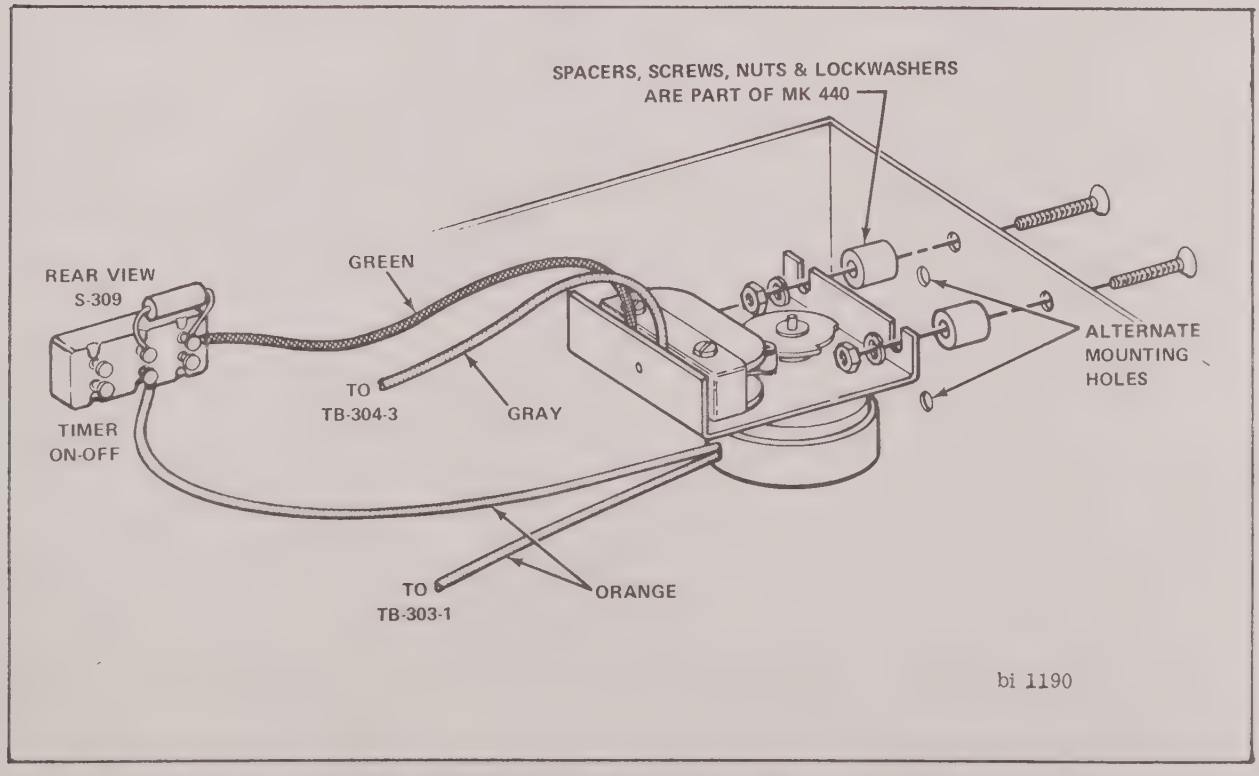


FIGURE 2-3 ONE-SECOND TIMER INSTALLATION

4. With screws loosened sufficiently, insert timer between standoff and hex nut as shown in figure 2-3. Tighten screws securely.

5. Attach orange wire with terminal lug to terminal board, TB-303, terminal 1.

6. Attach gray wire with terminal lug to terminal board, TB-304, terminal 3 (for right margin event marker).

7. Connect remaining orange wire to center terminal of timer switch S-309 as shown in figure 2-3.

8. Connect green wire to end terminal of timer switch S-309 as shown in Figure 2-3. Dress all wires into existing harnesses as necessary.

9. Install recorder in portable case (refer to Paragraph 2-5) or in mobile console.

2.8 INTERCHANNEL EVENT MARKER KIT INSTALLATION (Model 11-6222-02)

The Brush 440 Recorder may be equipped with up to four event markers, two standard and two accessory. Both accessory mid-channel event markers are kit model number 11-6222-02. To install this kit, refer to figure 2-4 and proceed as follows.

1. Raise pen access cover (not shown).

2. Install event marker in locations shown, and fasten with two 4-40 x1/4 screws and washers.

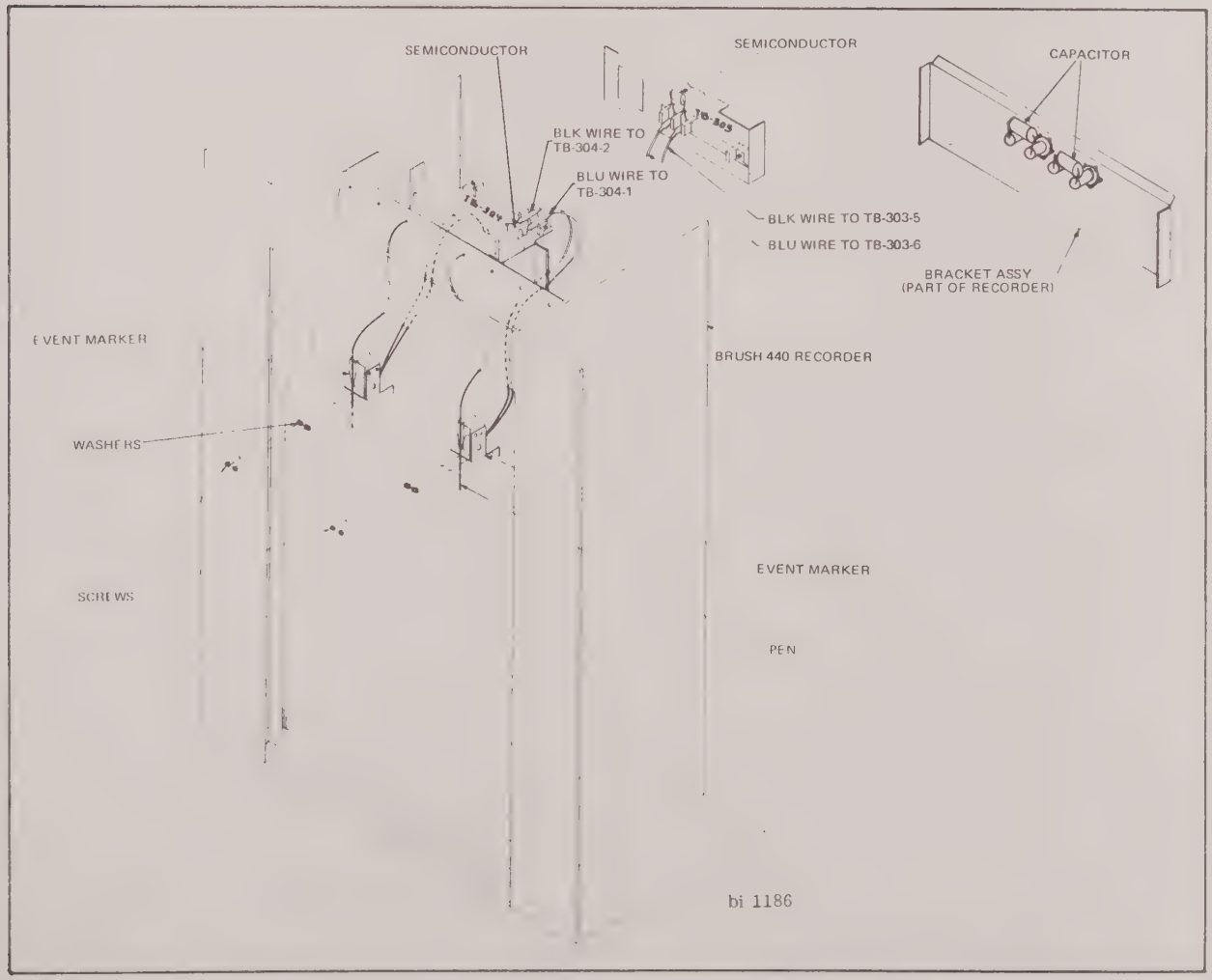


FIGURE 2-4 EVENT MARKER INSTALLATION

3. From left hand mid channel event marker, connect blue wire to TB-303, terminal 6. Connect black wire to TB-303, terminal 5.

4. Connect diode across TB-303, terminals 5 and 6, cathode end to terminal 5, and solder both terminals.

5. Install capacitor across event marker input terminals located on recorder input panel; solder both terminals.

6. From right hand mid channel event marker, connect blue wire to TB-304, terminal 1. Connect black wire to TB-304, terminal 2.

7. Connect diode across TB-304, terminals 1 and 2, cathode end to terminal 2, and solder both terminals.

8. Install capacitor across event marker input terminals located on recorder rear input panel; solder both terminals.

NOTE: All other wiring is pre-wired in the recorder.

9. Install pen ink tubing to any convenient unused manifold outlet.

10. Lower pen access cover.

2.9 OVERALL DIMENSIONS

Refer to Figure 2-5 for a drawing of complete outline dimensions.

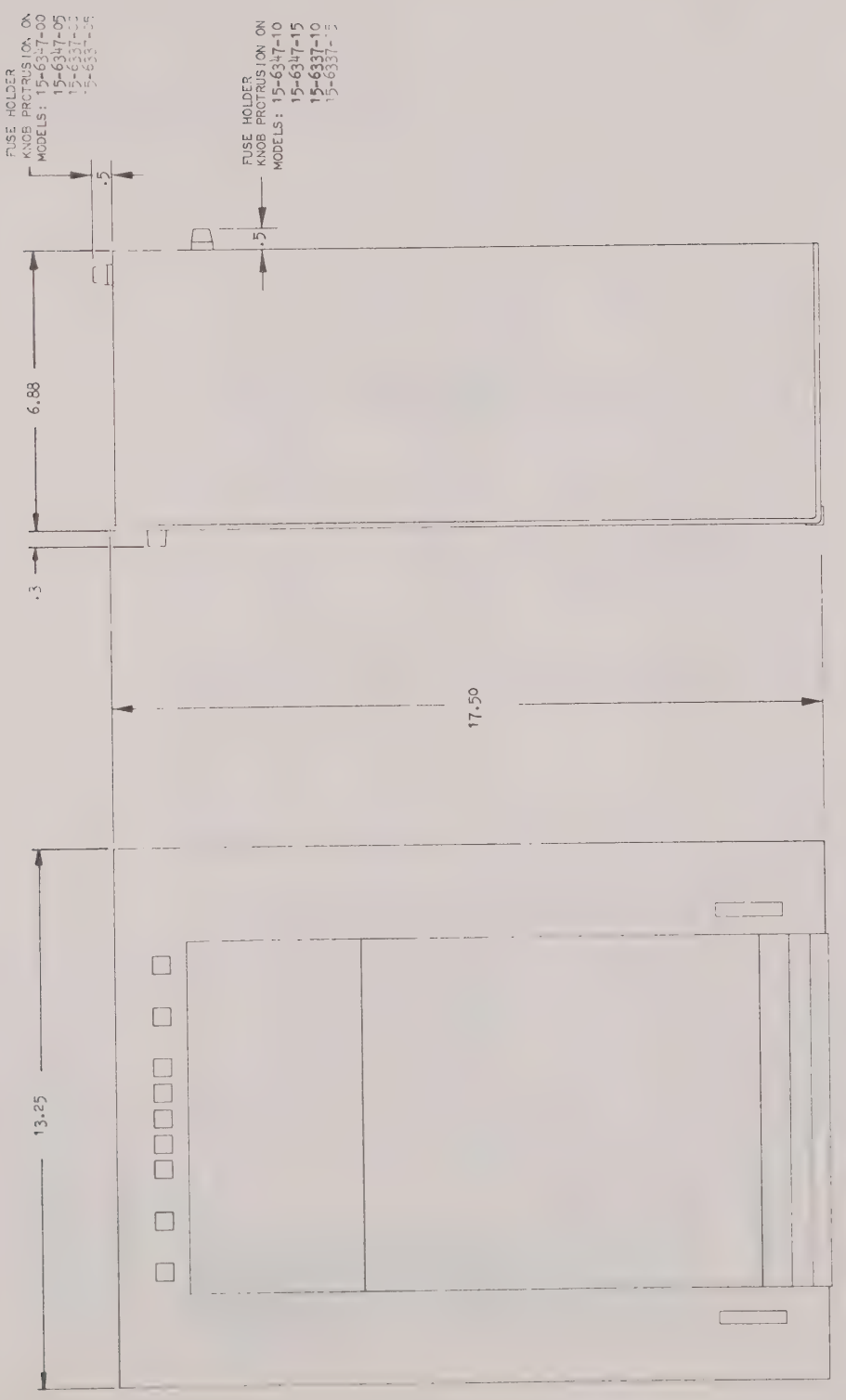


FIGURE 2-5 BRUSH 440 OUTLINE DIMENSIONS

SECTION III

OPERATION

3.1 GENERAL

This section describes and illustrates the controls on the Brush 440 Recorder and also provides instructions for proper operation.

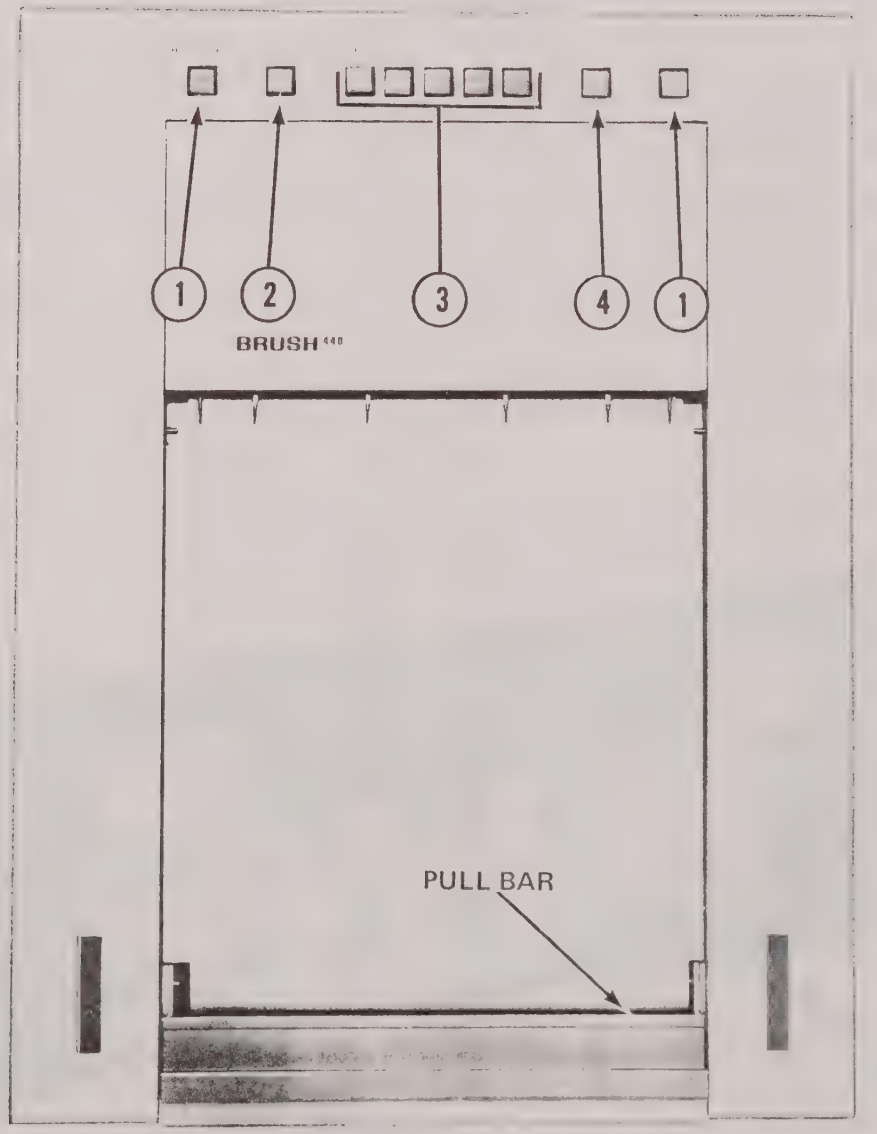


FIGURE 3-1 FRONT PANEL CONTROLS

3.2 FRONT PANEL CONTROLS

NOTE: Item numbers listed below correspond to circled numbers in Figure 3-1.

1 MARK EVENT Switch . . . . . Two momentary switches permit manual marking of an event. When left MARK EVENT button is depressed the left event marker pen will deflect to left. When the right MARK EVENT button is depressed the right event marker pen will deflect to right.

NOTE: The event marker pens will remain deflected until the MARK EVENT button is released.

2 POWER Switch . . . . . Controls a-c power to recorder. Depress button to turn recorder on or off. An internal lamp illuminates the pushbutton when recorder is on.

3 CHART SPEED MM/MIN Switch . . . . . Permits selection of four chart speeds and STOP. When in STOP position, chart drive is off, and pens will not respond to input signals. Depressing any chart speed button will activate the chart drive at the selected speed. Chart speeds may be changed while chart drive is running.

4 MM/SEC Switch . . . . . With this pushbutton depressed, all chart speeds are in millimeters per second.

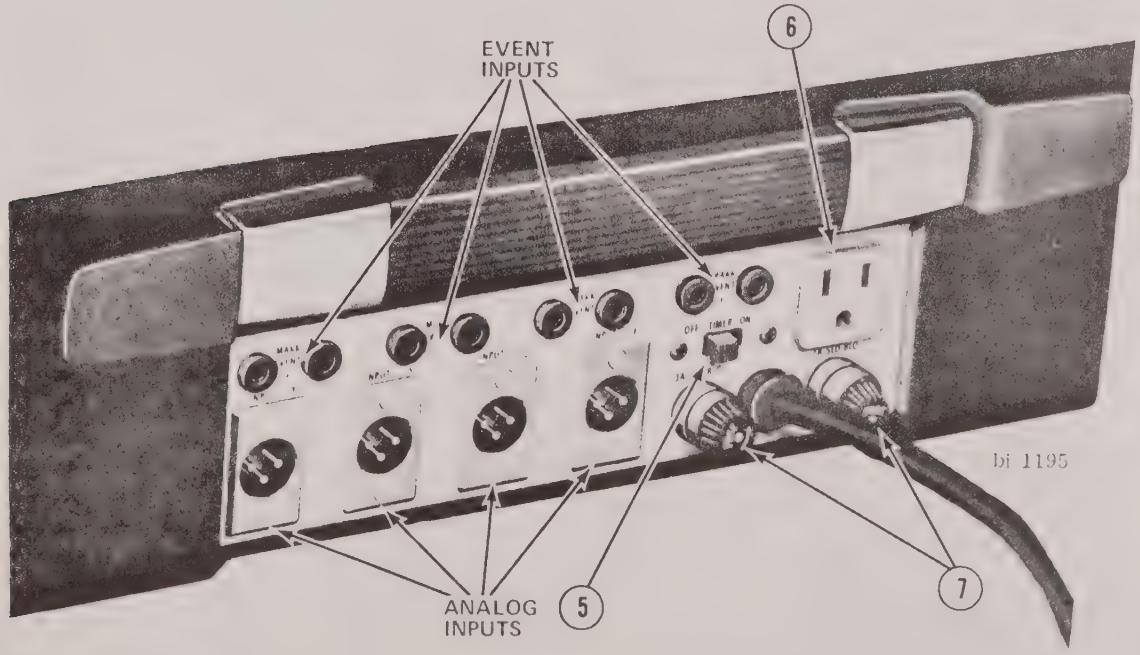


FIGURE 3-2 REAR PANEL CONTROLS

3.3 BACK PANEL CONTROLS

NOTE: Item numbers listed below correspond to circled numbers in Figure 3-2.

5 TIMER	Activates internal one second timer accessory, Model RA2101-10. Timer is connected to right event marker.
6 AUX	Convenience outlet, switched on with main POWER switch.
7 FUSES	Two fuses for main unit and auxiliary outlet.

3.4 RECORDER SET-UP AND OPERATION

CAUTION: CHECK TO BE SURE ALL PROCEDURES IN SECTION II, INSTALLATION, HAVE BEEN PERFORMED.

When preparing the Brush 440 Recorder for operation, be sure to observe all of the following steps:

1. With unit disconnected and all signal inputs disconnected, open writing table by pulling up on pull bar (see Figure 3-1) and be sure adequate paper for operation is on supply roll, and that it is properly threaded. (See threading diagram on side of writing table). If paper supply is exhausted or improperly threaded, refer to Para. 4.2 for complete instructions on changing chart paper. Close writing table firmly.

2. Connect unit to proper voltage and frequency as indicated on unit nameplate.

3. Depress POWER switch and observe that the POWER switch button is illuminated.

4. Depress 5 MM/SEC chart speed button and operate recorder to insure good ink flow on all channels. If no writing is present after first one foot of paper, refer to Para. 4.8 and check ink cartridges for adequate ink.

5. Now connect desired analog and event signals as described in Para. 2.2 Accessory one second timer may be operated by moving TIMER slide switch to on position.

6. Unit is now ready for operation.

The Brush 440 Recorder is designed to be non-inverting (a positive signal to pin 1 of input connector deflects pen to left). When using inverting preamplifiers (signal conditioners), a positive signal into preamplifier will deflect pen right. To avoid confusion, any channel in the Brush 440 can easily be converted to inverting configuration for use with inverting preamplifier. Refer to Para. 4.11 for complete instructions.

SECTION IV

MAINTENANCE

4.1 GENERAL

This section describes and illustrates removal, installation and adjustment procedures that can normally be performed by the operator.

4.2 CHANGING CHART PAPER

This paragraph describes and illustrates the procedures for changing the chart paper.

a. Removal

1. Press chart speed STOP button.
2. Turn recorder POWER off.
3. Grasp pull bar (Fig. 4-1) on bottom of writing table and pull out and up to place writing table in open position.

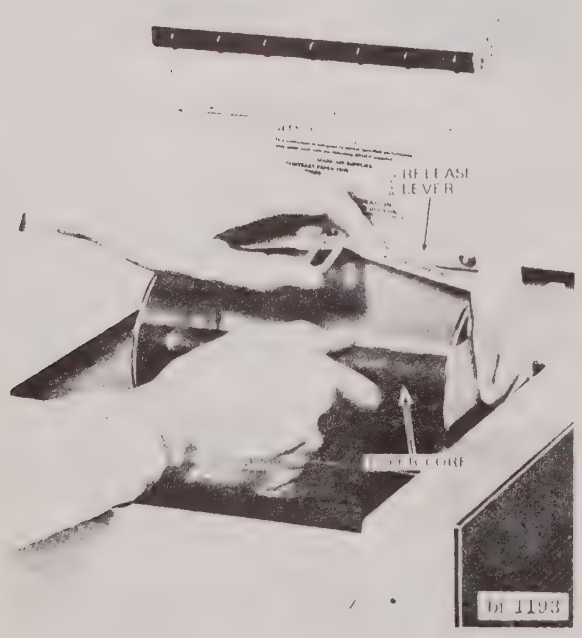


FIGURE 4-1 REMOVING PAPER SUPPLY ROLL

4. Hold paper supply roll and pull down on paper supply release lever (Fig. 4-1) and remove paper supply roll.
5. Unscrew left flange from paper supply shaft, remove and discard paper core. (Fig. 4-2)

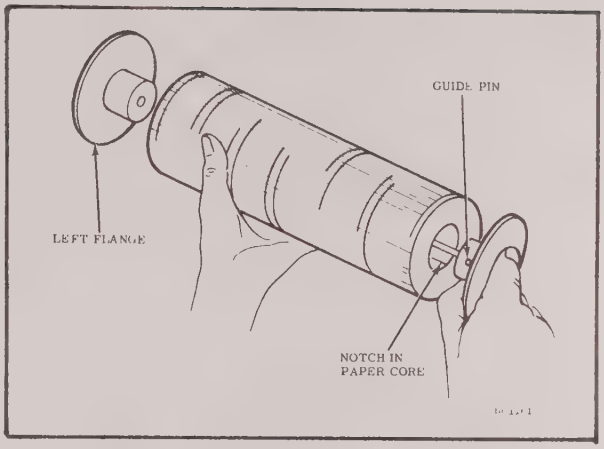


FIGURE 4-2 CHANGING CHART PAPER

b. Installation

1. Slide new paper roll onto paper supply shaft, making sure notches in paper core mate with guide pins in right flange. (Fig. 4-2)
2. Screw left flange onto paper supply shaft so flange is snug against paper edge.

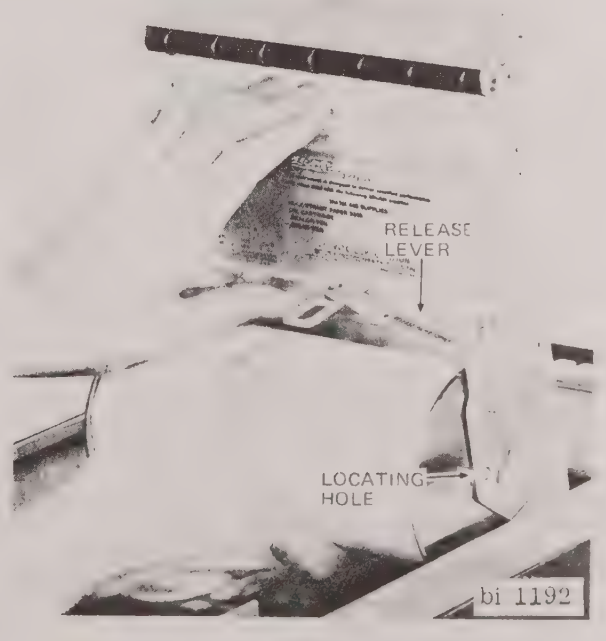


FIGURE 4-3 INSTALLING PAPER SUPPLY ROLL

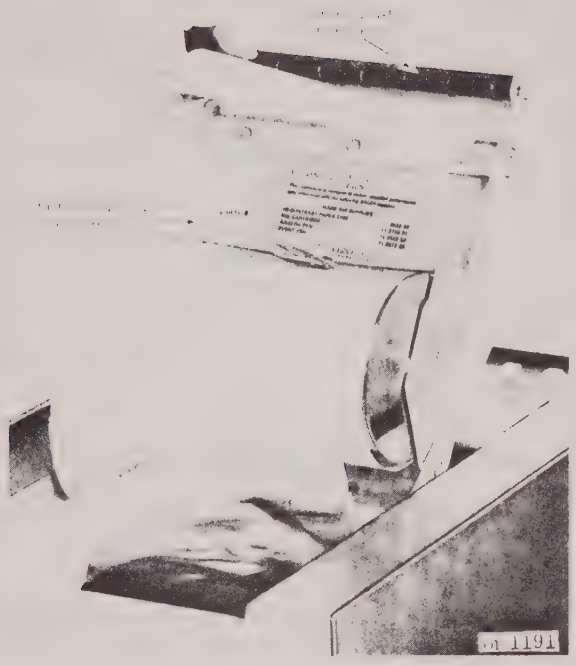


FIGURE 4-4 THREADING CHART PAPER

3. Insert paper supply roll shaft with paper into writing table assembly (Fig. 4-3) and push up release lever to lock shaft into position.

CAUTION: CHECK TO BE SURE SHAFT IS SEATED IN WRITING TABLE ASSEMBLY AND SHAFT ROTATES FREELY.

4. Feed paper over writing bar, through slot in front of writing table, behind pressure roll and out front of writing table assembly (Fig. 4-4). Refer to paper threading diagram on side of writing table assembly.

CAUTION: USE CARE DURING PAPER THREADING NOT TO DAMAGE PENS.

5. Slowly close writing table assembly while gently pulling on paper. When friction resists rotation of paper roll, pull paper taut, center on writing table, and close writing table.

NOTE: Check to be sure writing table is properly engaged by pressing on both sides of writing table.

6. Turn recorder on and operate at 125 millimeters per second to run out above two feet of chart paper to align chart paper.

4.3 REPLACING ANALOG PEN

This paragraph describes and illustrates removal, installation and adjustment of analog pens.

NOTE: Replace and adjust only one pen at a time.

a. Removal

1. Press chart speed STOP button and turn recorder POWER off.

2. Raise pen access cover by pulling out on bottom of access cover.

3. Use a flat-blade screwdriver and rotate individual ink valve button to OFF position (Fig. 4-5).

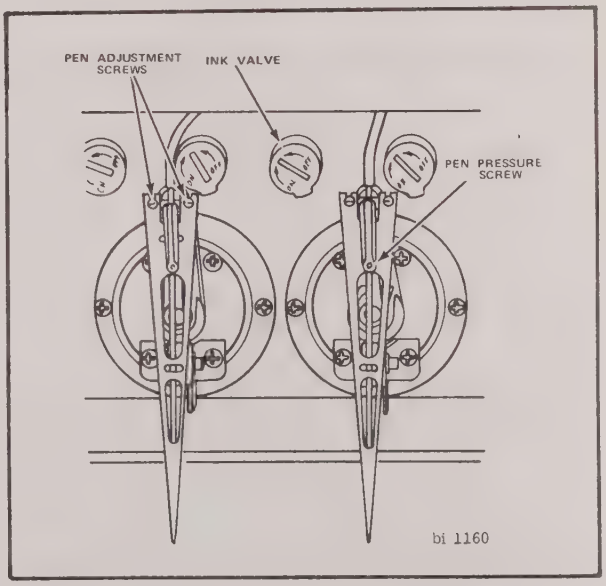


FIGURE 4-5 REPLACING PEN

4. Use pen tube replacement tool (part number 267528) and gently remove pen ink tube from manifold nipple (Fig. 4-6).

5. Use pen replacement wrench (part number 1-120922-2) and loosen set screw one-half turn through access hole in side of penmotor drive-arm shaft (Fig. 4-7) and remove wrench.

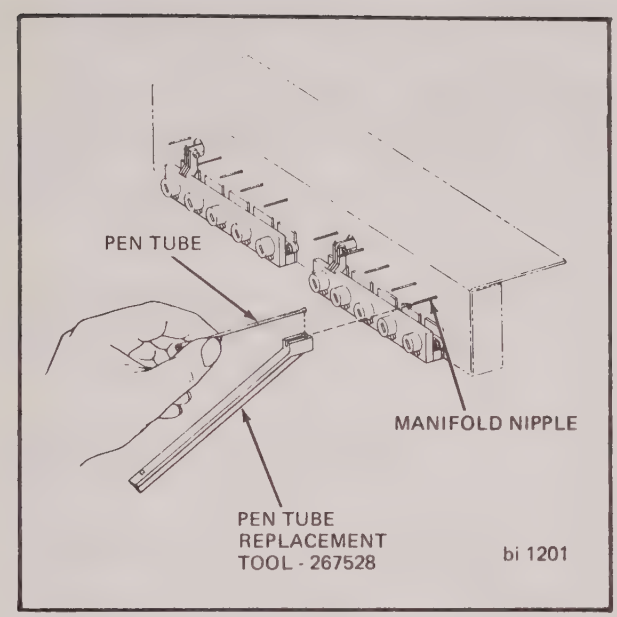


FIGURE 4-6 REPLACING PEN

NOTE: Do not loosen set screw more than one-half turn or pen cannot be removed from shaft.

6. Remove pen from penmotor drive arm shaft.

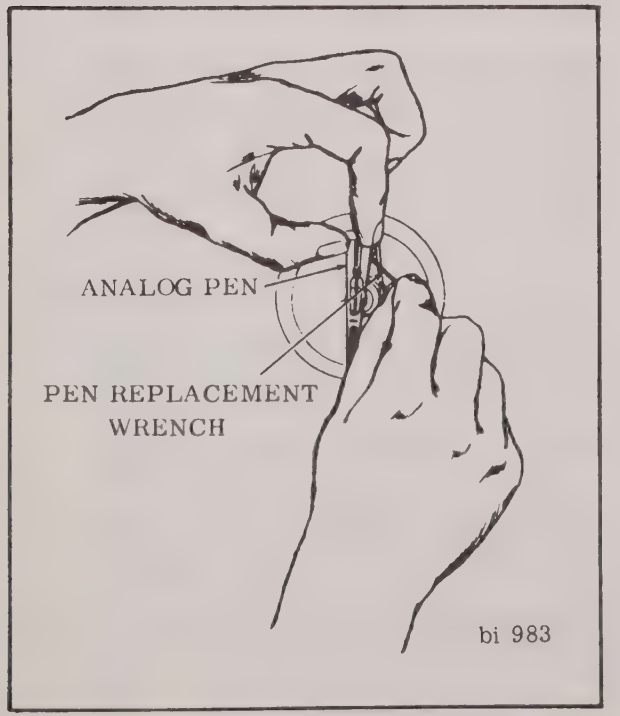


FIGURE 4-7 REPLACING ANALOG PEN

b. Installation

1. Carefully slide replacement pen onto penmotor drive arm shaft.

2. Align screw in pen hub with access hole in drive arm shaft and "snug up" set screw using pen replacement wrench, (part number 1-120922-2). Remove wrench.

NOTE: Set screw should be tightened to create friction, but loose enough to allow pen to be rotated in penmotor hub.

3. Install pen tube (3.3" long) between pen and manifold using pen tubing replacement tool (Fig. 4-6).

4. Use flat-blade screwdriver and turn individual ink valve to ON position.

5. Turn recorder POWER on, and operate recorder at 5 mm/sec.

6. Lift pen slightly to allow ink to bleed through pen tip.

7. Press recorder chart speed STOP button and turn recorder POWER off.

8. Gently grasp pen near hub and move pen across entire chart width (40 mm).

9. If ink trace is not parallel to a horizontal time line, gently turn pen in penmotor drive arm until trace is parallel to time line.

10. Tighten set screw securing pen in penmotor drive arm shaft and remove wrench.

11. If pen tip is not on same time line as other analog pens, loosen two pan head adjustment screws (Fig. 4-5) and slide pen up or down until all pen tips are on the same time line, and tighten 4.6).

NOTE: The following steps pertain to Pen, Model 11-2823-33 only. For instructions on Extended Life Pen, Model 11-2823-34, refer to Para. 4.10.

12. New pen must be lapped before proceeding. Carefully raise pen tip just enough to slide a small strip of emery paper (3M wet or dry Tri-m-ite paper, Grit M600, Brush part number 669234) under pen tip.

13. Move emery paper back and forth five or six times, parallel to chart time lines.

CAUTION: MAKE SURE THAT EMERY PAPER IS HELD FLAT AGAINST THE CHART PAPER TO INSURE PROPER LAPPING OF PEN.

14. Remove emery paper, operate recorder at 5 mm/sec and check pen for dryness.

15. If writing is not dry, proceed with normal pen lapping as described in Para. 4.8.

16. Lower pen access cover.

4.4 REPLACING EVENT PEN (MODEL 11-2873-20)

This paragraph describes and illustrates removal and installation of the event marker pen.

a. Removal

1. Press chart speed STOP button and turn recorder POWER off.

2. Raise pen access cover by pulling out on bottom of access cover.

3. Use a flat-blade screwdriver and rotate individual ink valve button to OFF position.

4. Use pen tube replacement tool (part number 267528) and gently remove pen ink tube from manifold nipple (Fig. 4-6).

5. Loosen two adjustment screws attaching pen to event marker and remove pen from event marker.

b. Installation

1. Slide replacement pen onto event marker and align pen tip on vertical grid line and on same time line as analog pens.

2. Tighten two screws attaching pen to event marker.

3. Install pen tube (4.5" long) between pen and manifold using pen tubing replacement tool (Fig. 4-6).

4. Use flat-blade screwdriver and rotate event marker ink valve button to ON position (Fig. 4-5).

5. Turn recorder POWER on and operate recorder at 5 mm/sec.

6. Lift pen slightly to allow ink to feed through pen tip.

7. Check pen pressure and adjust if required (Para. 4.6).

8. New pen must be lapped before proceeding. Carefully raise pen tip just enough to slide a small strip of emery paper (3M wet or dry Tri-m-ite paper, Grit M600, Brush part number 669234) under pen tip.

9. Move emery paper up and down five or six times, parallel to division lines.

CAUTION: MAKE SURE THAT EMERY PAPER IS HELD FLAT AGAINST THE CHART PAPER TO INSURE PROPER LAPPING OF PEN.

10. Remove emery paper, operate recorder at 5 mm/sec and check pen for dryness.

11. If writing is not dry, proceed with normal pen lapping as described in Para. 4.7.

12. Lower pen access cover.

4.5 REPLACING PENMOTOR BAND ASM

NOTE: Drive arm assembly is a non-replaceable part of the penmotor. If drive arm is broken or damaged in any way, entire penmotor must be replaced.

The penmotor band assembly (Brush part number 680294–40mm, 242999-910-80mm) should not be removed unless broken. Because the band tension is critical, a band replacement tool (part number 341409-915) must be used to replace band assembly.

NOTE: Penmotor need not be removed from recorder. Refer to Figures 4-8 and 4-8A.

1. Remove analog pen (Para. 4.3).

2. Remove socket-head screw and band clamping (curved) washer that secures band assembly to drive arm (use wrench 1-120922-3).

3. Remove two socket-head screws and lock washers securing band assembly to drive arm bracket. Discard damaged band assembly (use wrench 245218-5).

CAUTION: TO PREVENT DAMAGE TO THE NEW BAND ASSEMBLY, CHECK TO BE SURE DRIVE ARM AND BRACKET ARE FREE OF NICKS, DIRT, INK BEFORE INSTALLING NEW BAND ASSEMBLY.

4. Position new band assembly around drive arm hub. Align mounting holes with tapped holes in drive arm bracket and install two screws and lock washers. Do not tighten screws.

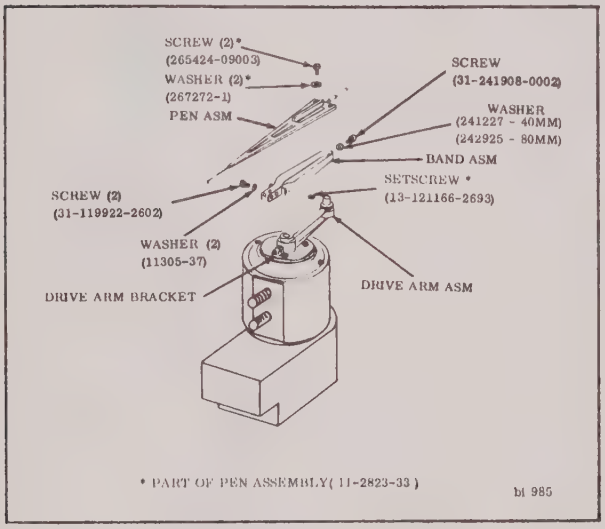


FIGURE 4-8 PENMOTOR BAND ASM

NOTE: Check to be sure curved portion of washer is positioned to conform to the radius of the drive arm hub. Use care not to nick or scratch band assembly.

5. Carefully install band clamping washer and socket-head screw.

6. Inspect band for proper positioning around drive arm hub so that equal pressure is maintained on top and bottom of band assembly.

7. Install band tool on penmotor and thread knurled thumb screw into drive arm bracket.

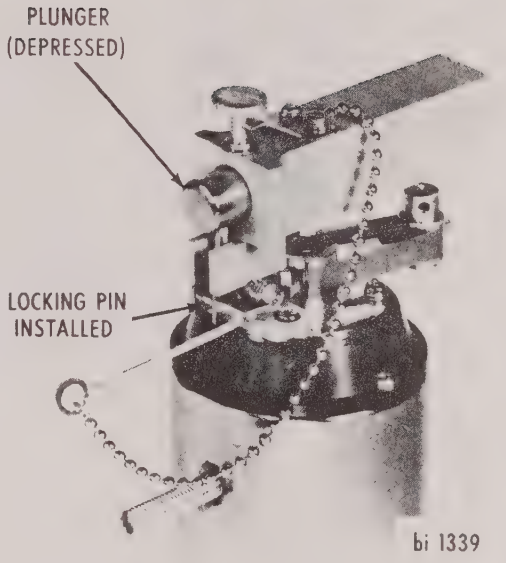


FIGURE 4-8A BAND TOOL MOUNTING

8. Depress plunger and insert locking pin into two small holes of band assembly, making certain plunger is behind locking pin.

9. Tighten two screws in drive arm bracket, loosen one quarter-turn, move drive arm back and forth several times to center band assembly and tighten screws.

10. Move drive arm back and forth several times to center band assembly on drive arm and tighten socket-head screw securing band assembly to drive arm.

NOTE: Do not tighten more than 16 inch-ounces.

11. Depress plunger and remove locking pin.

12. Loosen knurled screw securing band tool to drive arm bracket and remove tool.

13. Apply glyptal cement (or equivalent) to heads of the three screws to prevent working out.

14. Install analog pen (Para. 4.3).

4.6 PEN PRESSURE MEASUREMENT AND ADJUSTMENT

Analog or event marker pen pressure should be checked if the ink trace is excessively wide (bleeding), indicating low pen pressure or if pen gouges the chart paper, indicating excessive pen pressure.

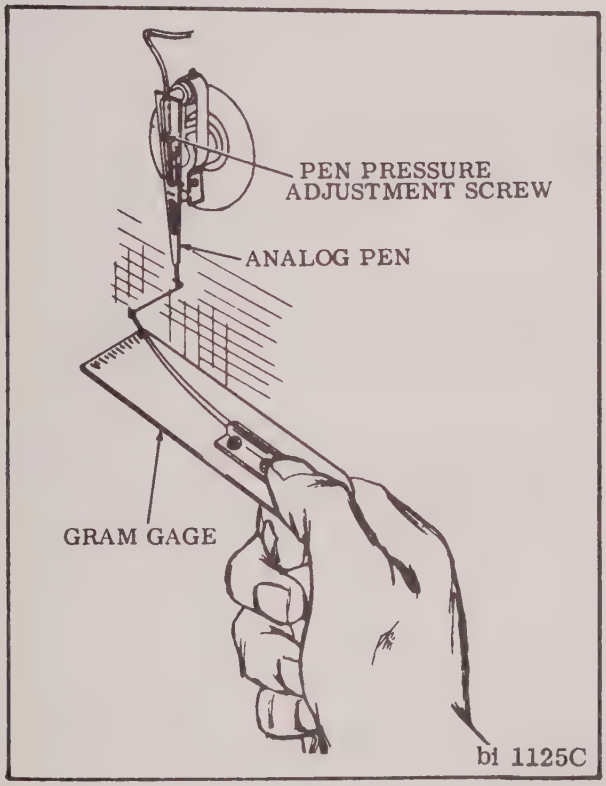


FIGURE 4-9 PEN PRESSURE MEASUREMENT

NOTE: Wide trace may also indicate an improperly lapped pen. Refer to Paragraph 4.7 for pen lapping procedures.

The gram gage (part number 240601-910) is used to measure the pressure of the analog and event marker pens as follows:

FIGURE 4-10 PEN PRESSURE ADJUSTMENT

1. Depress POWER on button to turn on recorder.
2. Raise pen access cover (located above writing table) by pulling out the bottom of access cover.
3. Press the 5 MM/SEC chart speed button.
4. Place gram gage hook under pen shaft as close as possible to tip and form a right angle to pen shaft with gage hook (Fig. 4-9).
5. Pull pen from chart and take reading on gage the moment excessive ink starts to flow from pen.

6. Proper writing pressure for analog pens is 28 to 32 grams. Event marker pen pressure is 20 to 25 grams.

7. Use pen pressure adjustment wrench (part number 1-120922-18) and turn adjusting screw (Figs. 4-5 and 4-10) clockwise to increase pressure or counterclockwise to decrease pressure.

8. Check pen pressure with gram gage and continue adjustment until proper reading is obtained.

9. If pen pressure is correct for analog and event pens, lower access cover. Recorder is ready for operation.

4.7 PEN LAPPING

NOTE: The Extended Life Analog Pen, Model 11-2823-34, must be lapped as described in Para. 4.10.

a. General

This paragraph describes and illustrates the proper procedures for lapping the analog and event pens. Intermittent or "wet" ink trace are indications that pen pressure is incorrect or that pen requires lapping. Check for "wet" writing by operating the recorder at five mm/sec chart speed, (no signal applied). Check pen trace by wiping index finger, with moderate pressure, across trace approximately one inch below pen tip. If ink does not smear, pen

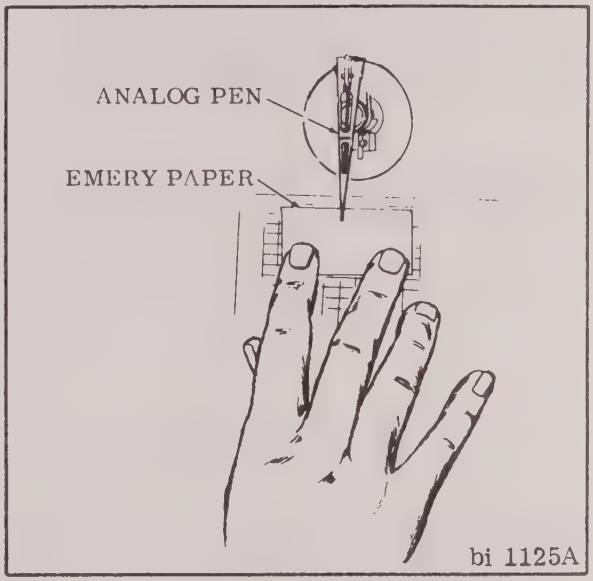


FIGURE 4-11 PEN LAPPING

is properly lapped. If trace smears, check and adjust pen pressure (Para. 4.6). Repeat test, and if trace continues to smear, lapping is required.

b. Lapping Procedure

NOTE: Lapping of pens should only be done when required.

1. Turn recorder off.
2. Raise pen access cover by pulling on bottom of access cover.
3. Carefully raise pen tip just enough to slide a small strip of emery paper (4/0) under pen tip. (Brush part number 141119) (see Fig. 4-11).

CAUTION: DO NOT USE A COARSE OR VERY ABRASIVE TYPE OF EMERY PAPER. USE ONLY THE GRADE SPECIFIED.

4. Move emery paper back and forth under pen tip, parallel to chart time lines, for a total distance of approximately two inches

CAUTION: MAKE SURE THAT EMERY PAPER IS HELD FLAT AGAINST THE CHART PAPER TO INSURE PROPER LAPPING OF PEN.

5. Remove emery paper, operate recorder at 5 mm/sec and check pen trace for dryness.
6. Repeat steps 1 thru 5 as required to obtain dry trace.
7. If pen tip should become blocked during lapping operation, touch pen at top of pen (above tip) with a hot soldering iron for a few seconds with the pen tip raised slightly off the paper. This will usually start ink flowing and flush out abrasive.

NOTE: If procedure is repeated more than three times, recheck pen pressure and repeat lapping. Strict adherence to above lapping procedures is imperative.

8. When dry trace is achieved, lower access cover.

4.8 INK CARTRIDGE REPLACEMENT (Figure 4-12)

This paragraph describes and illustrates the procedures for replacing ink cartridges, Model 11-2730-01.

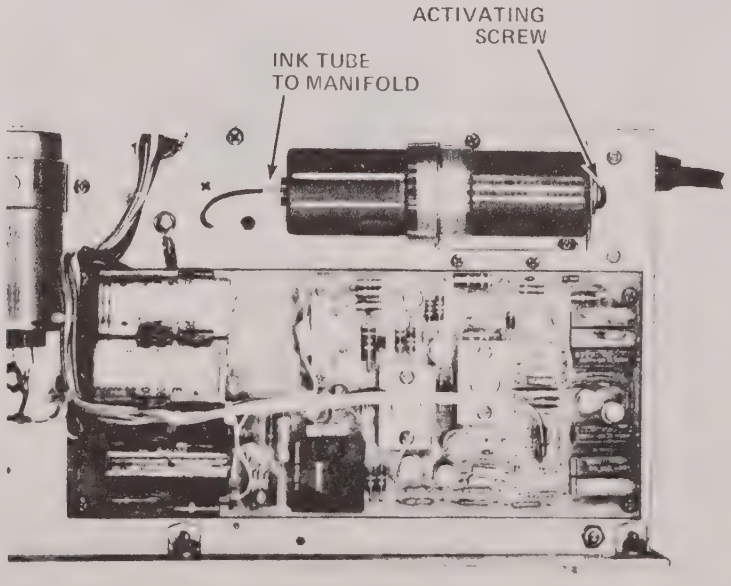


FIGURE 4-12 REPLACING INK CARTRIDGE

a. Removal

WARNING: CHECK TO BE SURE RECORDER IS TURNED OFF AND DISCONNECTED FROM POWER SOURCE.

1. Recorder must be removed from portable case or slid out of mounting rack sufficient to permit access to ink cartridges.
2. Turn activating screw clockwise until compression spring in ink plunger has been drawn up tight into ink plunger assembly and ink flow stopped.
3. Carefully remove ink tube from ink from ink cartridge.
4. Unscrew ink cartridge from plunger assembly and discard empty cartridge.

b. Installation

1. Remove and discard piston retainer from replacement cartridge (see Fig. 4-13).
2. Install ink cartridge on plunger assembly and tighten securely.
3. Remove and discard shipping cap from ink cartridge.
4. Install ink tube on cartridge.

NOTE: Do not use tweezers or other sharp instruments to install tubing.

5. Turn activating screw counterclockwise until snug to pressurize ink system.
6. This completes ink cartridge replacement procedure.

4.9 PEN CLEANING

In the event that a pen should fail to write or displays intermittent writing, it may be caused by a clogged pen. The procedure outlined below is intended as a guide to flush pens, but may not always prove effective.

1. Turn recorder off.
2. Close ink valve on affected channel.
3. Remove ink tubing from manifold (Fig. 4-6).

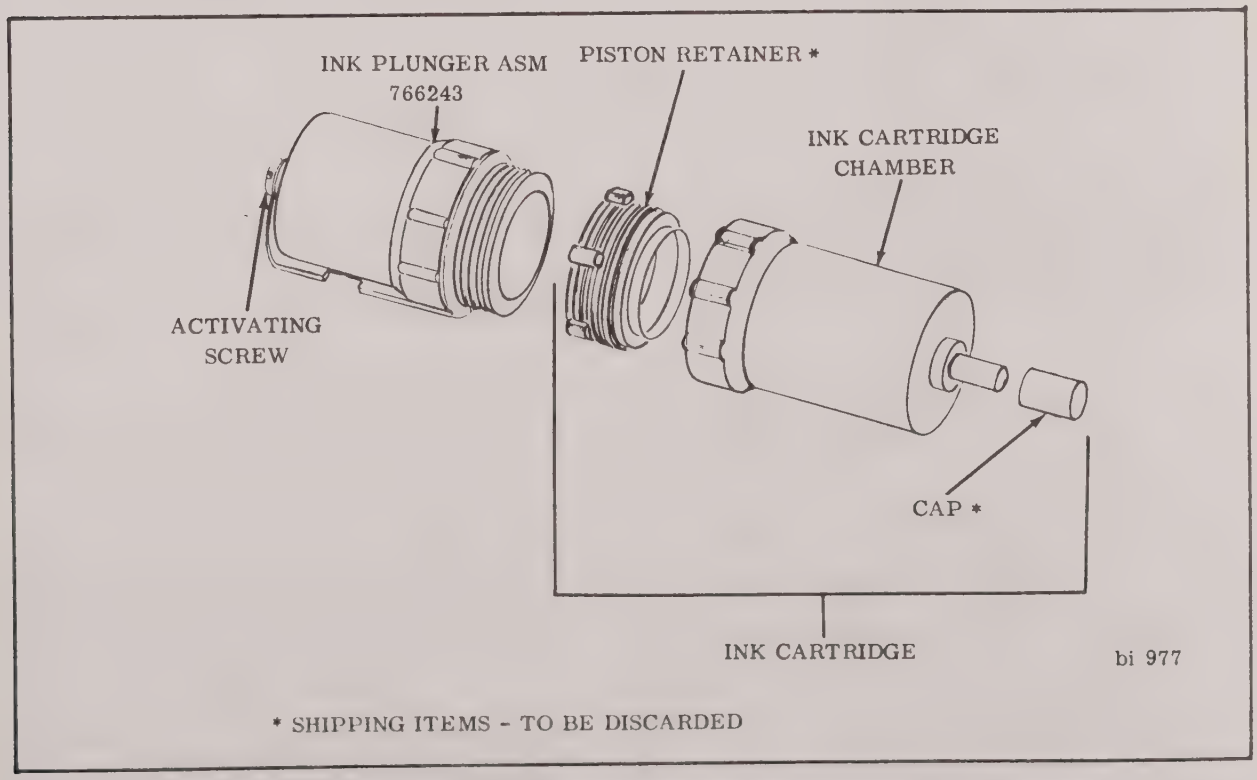


FIGURE 4-13 REPLACING INK CARTRIDGE

4. Remove pen (Para. 4.3a or 4.4a).

NOTE: Do not remove tubing from pen unless tubing is kinked or suspected of being defected.

5. Modify No. 18 hypodermic needle per Figure 4-15.

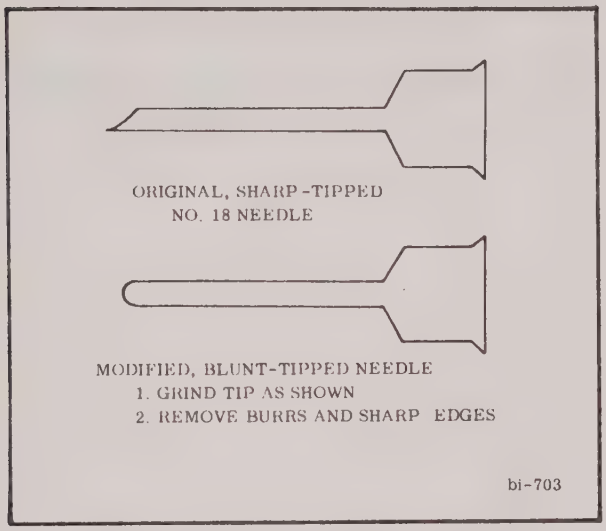


FIGURE 4-14 HYPODERMIC NEEDLE MODIFICATION

6. Attach modified needle onto 2cc hypodermic syringe.

7. With syringe plunger depressed, insert needle in pen tubing.

8. Immerse pen tip in cleaning agent (Isopropyl Alcohol, Cell-O-Solve or equivalent).

9. Back-flush by slowly withdrawing syringe plunger.

NOTE: It may be necessary to allow the pen to remain for a brief period in the cleaning agent to dissolve dried ink at pen tip.

10. Install pen (Para. 4.3b or 4.4b).

NOTE: Clogging of pens occurs only when proper adjustment, operation and/or handling as per Brush Operating Manual has not been adhered to.

4.10 LAPPING PROCEDURES FOR EXTENDED LIFE PEN, MODEL 11-2823-34

The Brush Model 11-2823-34 Extended Life Pen requires a different lapping procedure from that described in Para. 4.7. Install pen as described in Para. 4.3, but disregard lapping instructions referred to.

Lap Extended Life Pen as follows:

1. Raise pen access cover.

2. Shut off ink manifold knobs of all channels by rotating all knobs counterclockwise.

3. Raise writing table and rewind chart paper so that no paper is left under pen tips. Be sure sufficient paper is on roll to energize interlock switch to permit recorder operation.

4. Now set pen pressure to 30 grams against writing bar.

5. Place coarser of two lapping papers supplied (Brush part number 668965) under pen tip and drive pen at 60 Hz, 1/2 of full scale.

6. Simultaneously move lapping paper back and forth under pen. Lap in this manner for 90 seconds.

7. Now repeat procedure using finer lapping paper (Brush part number 668963) for 90 seconds.

8. Return recorder to normal operating condition (thread chart paper over writing bar and turn ink control knobs on).

NOTE: In most cases, one lapping will suffice, but occasionally two or three will be required to effect a proper seal.

9. If pen tip should become blocked during lapping operation, touch pen at top of bend (above tip) with a hot soldering iron for a few seconds with pen tip slightly raised off paper. This will usually start ink flowing and flush out abrasive.

10. Lower pen access cover.

4.11 INVERTING OR NON-INVERTING OPERATION

The Brush 440 Recorder is normally factory wired and calibrated as a non-inverting amplifier/recorder system. (That is, a positive signal into HI input terminal will deflect pen to left or positive.) When using the Brush 440 with Brush Signal Conditioners which have negative outputs, the Brush 440 Recorder should be modified to inverting operation. (In inverting operation, a negative signal into HI input terminal will deflect pen to left or positive.) This change involves a wiring change at the penmotor, and is reflected on the oscillograph schematic. This change is made as follows:

1. Change black (0) wire from pin 1 to pin 2, and white/black/red (902) wire from pin 2 to pin 1.

2. Change gray (8) wire from pin 3 to pin 4, and black (0) wire from pin 4 to pin 3.

3. Change blue (6) wire from pin 6 to pin 7, and black (0) wire from pin 7 to pin 6.

Recorder amplifiers must now be balanced. Refer to Section VI, Calibration.

4.12 SCHEMATICS

Before attempting electrical troubleshooting of the Brush 440, check to be sure the schematic number and revision letter stamped on the inside of the writing table (Figure 4-4) correspond with the schematic number and revision letter found at the rear of this manual.

MODEL NO.	SCHEMATIC
15-6347-00	269871
15-6347-05	280088
15-6347-10	269874
15-6347-15	280090
15-6337-00	280854
15-6337-05	280855
15-6337-10	280272
15-6337-15	280856

SECTION V

THEORY OF OPERATION

5.1 GENERAL

The Brush 440 Recorder consists of four analog channels, associated penmotor drive amplifiers and power supplies (Fig. 5-1). The input signal to each channel is single-ended floating.

Penmotor drive amplifier is a complete servo-type system utilizing a Metrisite Transducer in the penmotor to develop position and a Tachometer Generator to derive velocity.

5.2 DETAILED DESCRIPTION (Fig. 5-2)

a. Regulated D.C. Power Supply

Primary power to each channel is applied to transformers T-301 thru T-304 and rectified by full wave rectifier bridge, CR-215. The output voltages, plus and minus 32 volts d-c are applied to the output stages of the drive amplifier. Regulated plus and minus 18 volts d-c to amplification stages of drive amplifier are derived from resistors R-230 and R-231, and zener diodes CR-209 and CR-210.

b. Drive Amplifier and A.C. Feedback Circuit

The drive amplifier acts as an error amplifier in that the input signal is constantly compared with pen position and assures that pen position on the chart accurately displays the input signal.

The summing of the amplifier is at the input of amplifier IC-201. The input signal is summed thru resistor, R-218. The demodulated signal from the position sensing transducer (Metrisite) is summed thru resistor R-226. Resistor, R-225, serves as a summing resistor for the zero adjustment current thru ZERO control, R-223. Resistor, R-228, serves as the open-loop feedback path for the amplifier. Resistor, R-227, sums the velocity feedback signal which is derived from a tachometer generator within the penmotor. DAMPING control, R-234, permits adjustment for optimum frequency response and waveform reproduction.

Any error voltage is amplified by amplifier, IC-201, transistors, Q-206 and Q-207, which form a phase-splitting driver stage for the output transistors, Q-208 and Q-209.

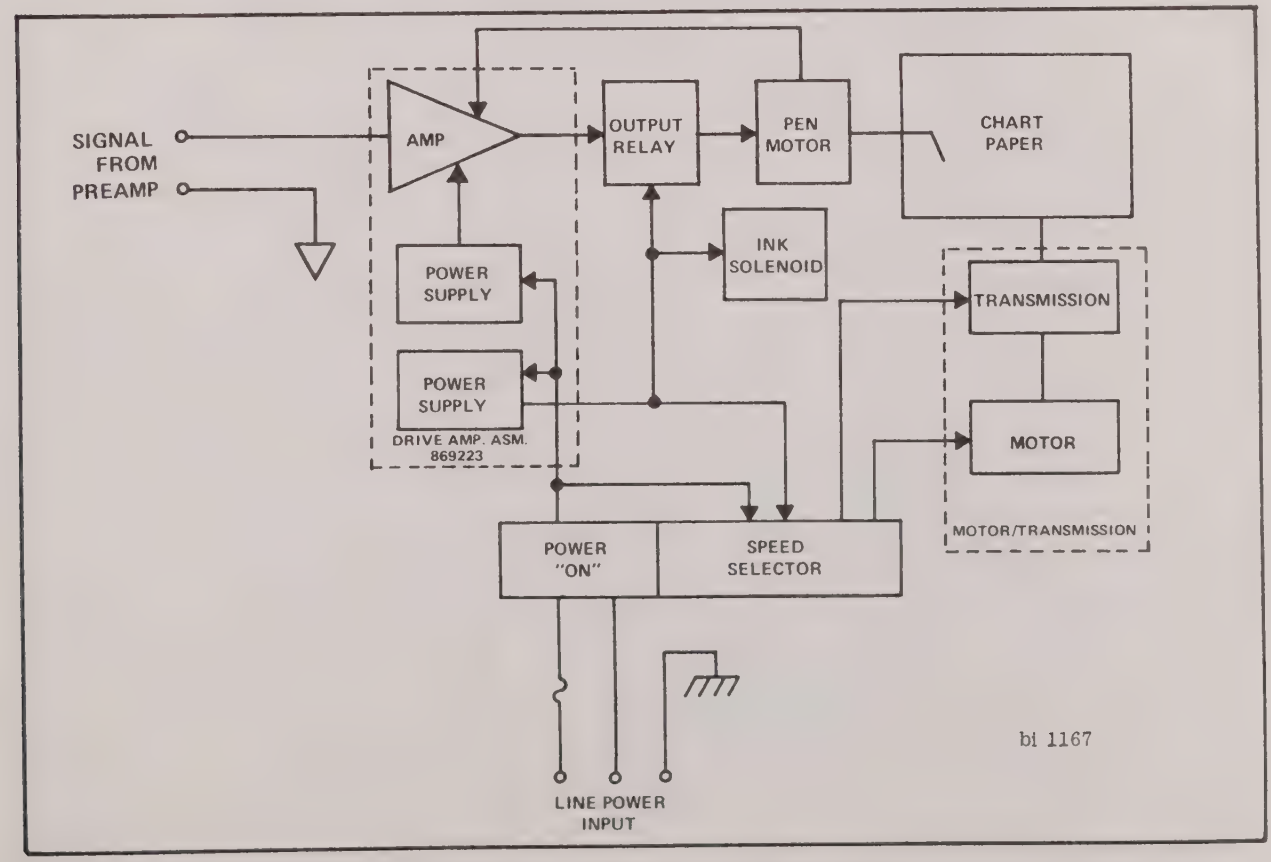


FIGURE 5-1 THEORY OF OPERATION

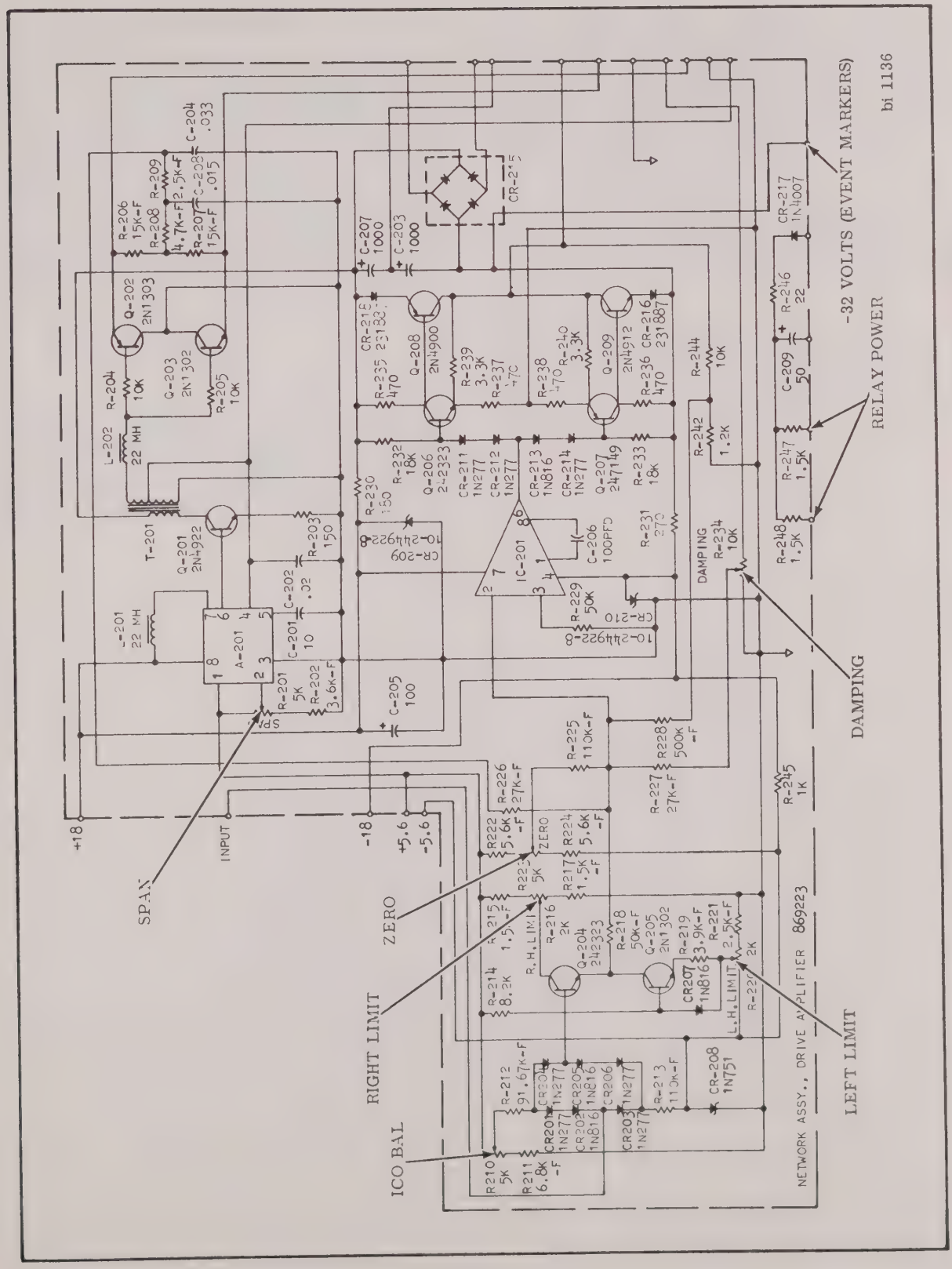


FIGURE 5-2 AMPLIFIER AND POWER SUPPLIES NETWORK ASSEMBLY 869223

c. Left and Right Limiter Circuit

The output of the preamplifier is applied to the base of an emitter-follower transistor, Q-204 through diode network CR-201, CR-202, CR-203, CR-204, CR-205 and CR-206. The diode network provides the necessary bias and temperature compensation to assure a stable output from the limiters. Transistor Q-205 functions as a current source and emitter load for transistor Q-204. RIGHT LIMIT adjust, R-216 and LEFT LIMIT adjust, R-220 limit the voltage swing of transistor Q-204 which instantaneously clips any excess voltage applied to the limiters.

d. 20 KHz Oscillator and Demodulator Circuits

Oscillator, A-201 contains the 20 KHz circuit. Amplitude adjustment is provided by applying a variable d-c voltage from variable resistor, R-201, to terminal 2 of the module. An additional terminal (pin 4) is provided to allow additional components to be added to oscillator control loop.

The oscillator output voltage is amplified by transistor, Q-201 and further stepped up by transformer, T-201, which has a tapped secondary winding providing two outputs. One output (tap) is applied to primary of position-sensing transducer (Metrisite). This same output is applied to oscillator, A-201, to correct for any change in output amplitude from transformer, T-201.

The second output voltage of transformer, T-302 is applied thru reactor, L-202, (phase-shifting coil) to the phase-sensitive demodulator consisting of transistors, Q-202 and Q-203, and resistors R-204 and R-205.

The varying output voltage from the Metrisite is then applied to the demodulator circuit across resistors, R-206 and R-207. The demodulated and filtered output of the Metrisite circuit is then applied to the error amplifier thru resistor, R-226.

SECTION VI

CALIBRATION

6.1 GENERAL

The Brush 440 Recorder has been factory calibrated, and under normal conditions will not require calibration. However, because of parts replacement or repair, calibration may be necessary. This section describes and illustrates the correct calibration procedures. It should be pointed out that calibration should only be performed by qualified personnel familiar with procedures and standards.

6.2 TEST EQUIPMENT REQUIRED

The following is a list of recommended test equipment necessary for calibration.

NOTE: Specific manufacturer need not be adhered to, but comparable equipment is mandatory, since accuracy stated is imperative.

a. Function Generator (Hewlett-Packard, Model 202A, or equivalent).

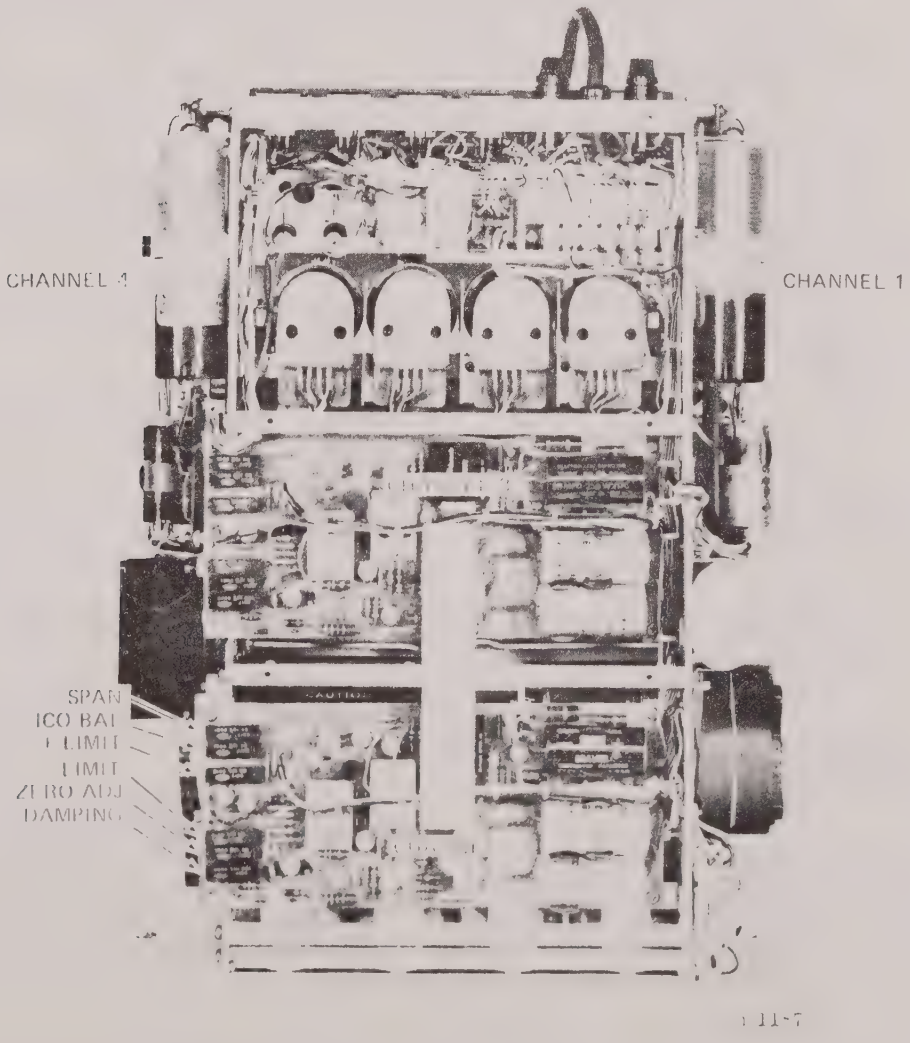


FIGURE 6-1 CALIBRATION CONTROLS

b. D.C. Power Supply, 0 to 5 volts ±0.1% (floating).

NOTE: A precision voltmeter (Fluke 883A or equivalent) may be used to monitor D.C. Power Supply to insure accuracy if precision D.C. Power Supply is not available.

6.3 PROCEDURE

NOTE: Procedure outlined is typical of all channels.

1. Remove unit from case (Para. 2.8) or slide unit forward out of rack to expose calibration controls (Fig. 6-1).

2. Connect unit to proper power source as indicated on unit nameplate.

3. Depress POWER on pushbutton and allow a fifteen minute warm-up time.

4. Depress 5 mm/sec chart speed button. Alternately open and short input terminals of channel being checked. Adjust ICO BAL for no change in pen deflection.

5. Continue to operate chart at 5 mm/sec and set pen to exact chart center with ZERO ADJ control.

6. Now apply ±2.5 volts ±0.1% to input terminals. Adjust SPAN control for 25 divisions of pen deflection.

NOTE: If input signal will be primarily square wave perform steps in 6.4. If input signal will be primarily sine wave, perform steps in 6.5.

6.4 SQUARE WAVE FREQUENCY RESPONSE

7. Apply a 1 Hz square wave of 25 divisions peak-to-peak amplitude. Adjust DAMPING control for best wave-form reproduction.

8. Check frequency response by applying a 10 Hz square wave 10 divisions peak-to-peak. Increase frequency to 100 Hz; amplitude response must remain flat (± 1 division). Increase frequency to 125 Hz; amplitude should be 7 divisions. Adjust DAMPING control if necessary.

9. Apply a 4 Hz square wave, 50 divisions peak-to-peak. Increase frequency to 40 Hz. Amplitude should remain flat at 50 divisions, ± 1 division.

10. Apply positive 3 volts d-c to input and adjust LEFT LIMIT control to bring pen 1-½ to 2 divisions beyond chart edge.

11. Apply negative 3 volts d-c to input and adjust RIGHT LIMIT control to bring pen 1-½ to 2 divisions beyond chart edge.

This completes unit calibration. Depress chart STOP button and disconnect all test equipment. Replace unit in case (Para. 4.3) or slide unit into rack. Unit is ready for operation.

6.5 SINE WAVE FREQUENCY RESPONSE

7. Apply a 1 Hz sine wave of 25 divisions peak-to-peak amplitude. Adjust DAMPING control for best wave-form reproduction.

8. Check frequency response by applying a 10 Hz sine wave 10 divisions peak-to-peak. Increase frequency to 100 Hz; amplitude response must remian flat (± 1 division). Increase frequency to 125 Hz; amplitude should be 7 divisions. Adjust DAMPING control if necessary.

9. Apply a 4 Hz sine wave, 50 divisions peak-to-peak. Increase frequency to 40 Hz. Amplitude should remain flat at 50 divisions, ± 1 division.

10. Apply positive 3 volts d-c to input and adjust LEFT LIMIT control to bring pen 1-½ to 2 divisions beyond chart edge.

11. Apply negative 3 volts d-c to input and adjust RIGHT LIMIT control to bring pen 1-½ to 2 divisions beyond chart edge.

This completes unit calibration. Depress chart STOP button and disconnect all test equipment. Replace unit in case (Para 4.3) or slide unit into rack. Unit is ready for operation.

SECTION VII

PARTS IDENTIFICATION

7.1 GENERAL

This recorder has been accurately calibrated and adjusted before shipment from the factory and should give long, trouble-free service. For servicing beyond the scope of the instructions contained in this manual or the technical equipment available, contact your nearest Brush Service Engineer listed on the warranty card shipped with the recorder.

The following parts lists and schematic diagrams are designed to assist in servicing and repairing the recorder.

NOTE: Check to be sure the schematic number and revision letter stamped on the inside of the writing table of the recorder agree with the number and revision letter on the schematic contained in this section.

To assure prompt and satisfactory delivery of replacement parts, include the following with the purchase order:

1. Name, model number, and serial number of the instrument

   For example: Brush 440 Recorder, Model 15-6347-00, Serial number _____

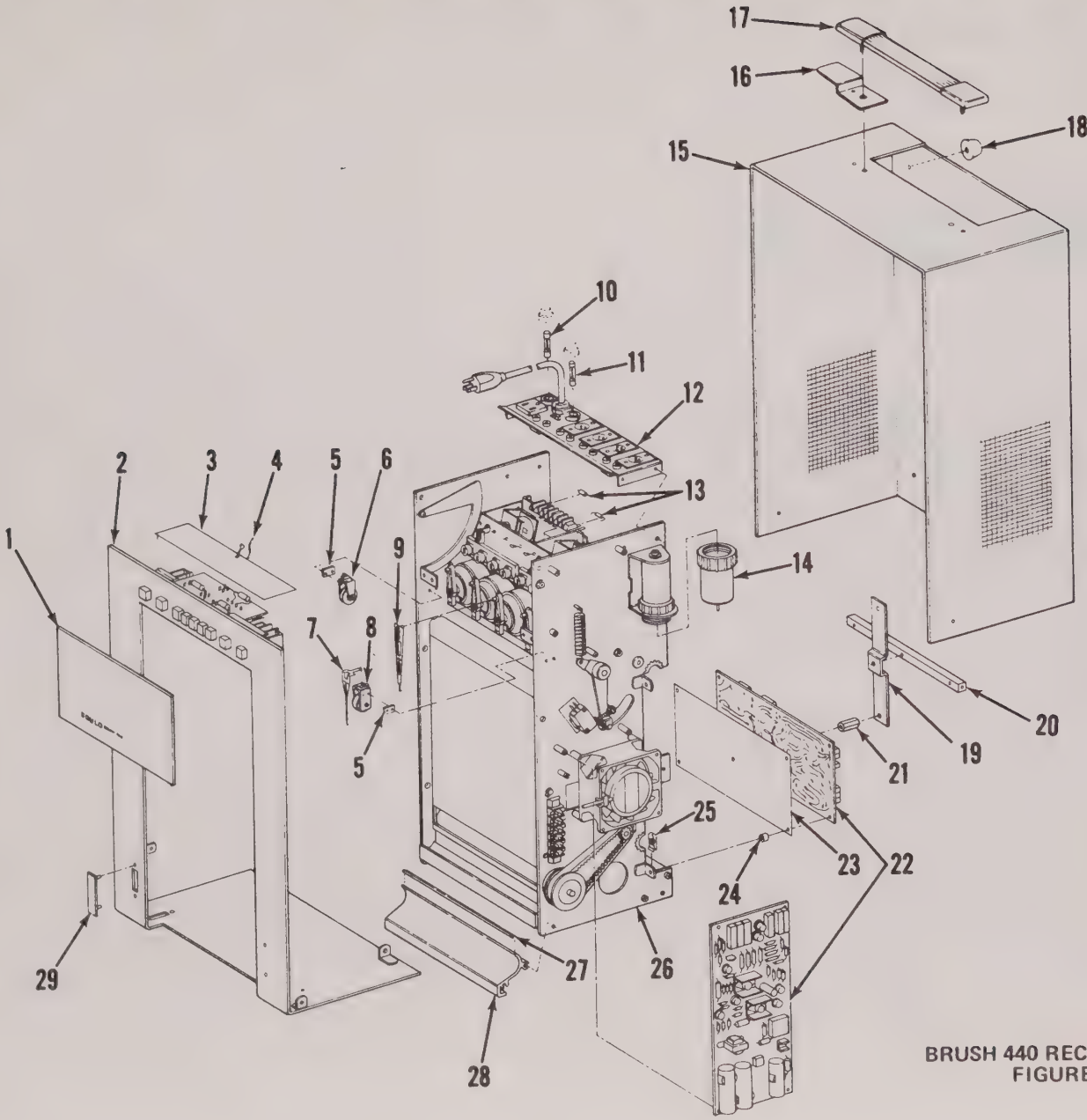
2. Description of the part as listed in the manual

3. Brush part number

NOTE: Do not use the SYMBOL NUMBER from the parts list for identifying desired parts on the order.

EXPLODED VIEW PARTS LIST
BRUSH 440 RECORDER ASM
FIGURE 7-1

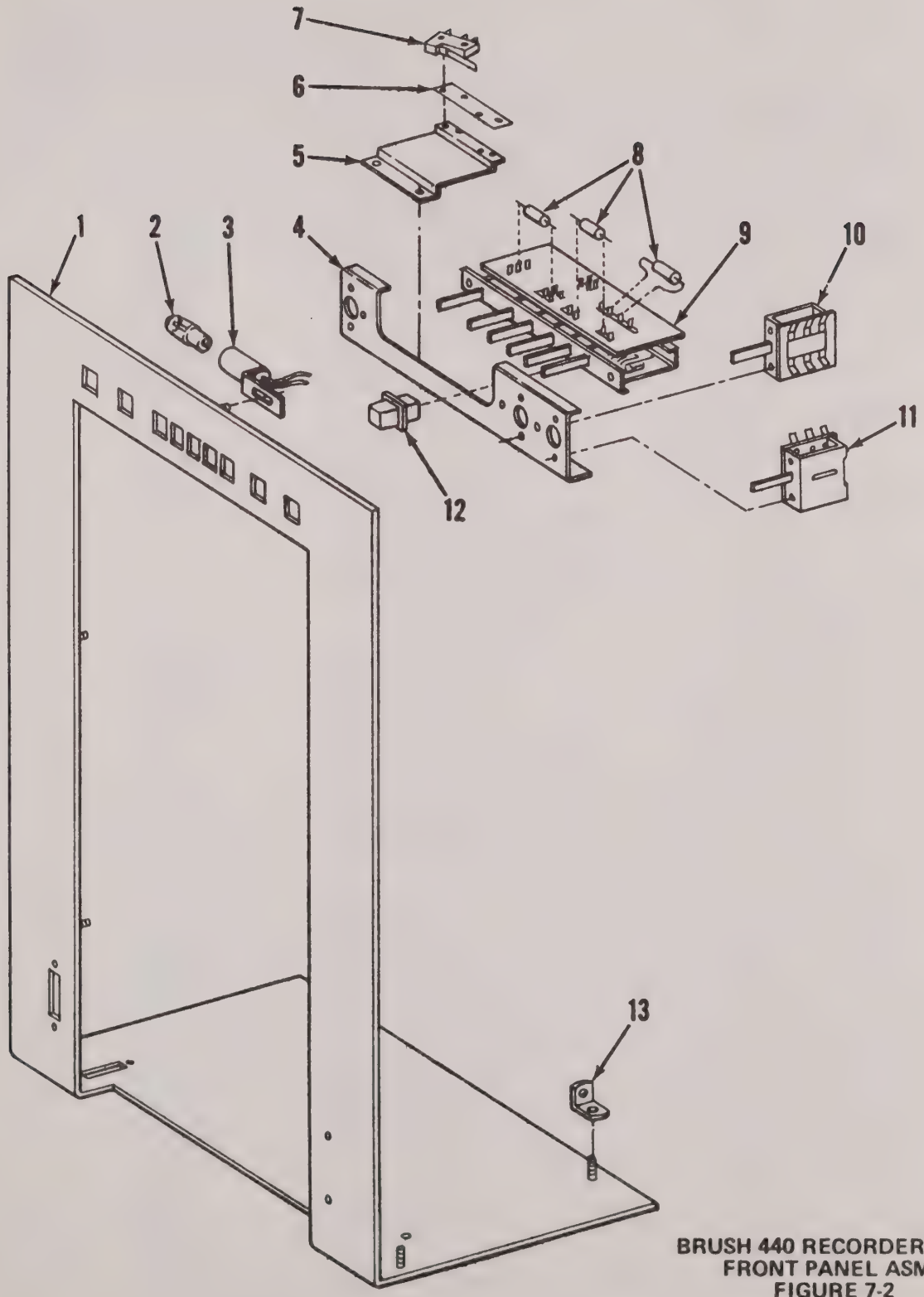
ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	769553	Panel Subassy, Door-Pen	
2	869794	Panel Assy, Front (-00, -05) Fig. 7-2	
2	869801	Panel Assy, Front (-10, -15) Fig. 7-2	
3	280280	Insulation	
4	232997-3	Strap, Retaining	
5	269791	Spacer, Event Marker	
6	11-2123-31	Event Marker Assy, LH	
7	11-2873-20	Pen Assy, Event	
8	11-2123-32	Event Marker Assy, RH	
9	11-2823-33	Pen Assy, Analog	
10	116198-10	Fuse, Slo-Blo (-00, -10)	F-302
10	266924-7	Fuse, Slo Blo (-05, -15)	F-302
11	116198-13	Fuse, Slo-Blo (-00, -10)	F-301
11	266924-1	Fuse, Slo-Blo (-05, -15)	F-301
12	869814	Bracket Assy, Connector (6347 series) Fig. 7 4	
12	880239	Bracket Assy, Connector (6337 series) Fig. 7 4	
13	231887	Semiconductor, Diode	CR-301, 304
14	11 2730 01	Ink Cartridge Assy	
15	669591	Case Subassy	
16	269753	Bracket, Power Cord	
17	280285-2	Handle	
18	120903 221	Bumper	
19	269699	Strap	
20	269546	Spacer	
21	244501-14	Spacer	
22	869223	Network Assy, Drive Amp – Fig. 7-11	
23	369896	Insulator	
24	1 269573-3	Spacer	
25	4 103838-11	Nut Sheet, Spring	
26	869819	Chassis Assy (-00, -05) Fig. 7-3	
26	869878	Chassis Assy (-10, -15) Fig. 7-3	
27	249668	Deflector, Paper	
28	769583	Chute, Paper	
29	246388	Cover, Panel	



BRUSH 440 RECORDER ASM
FIGURE 7-1

EXPLODED VIEW PARTS LIST
FRONT PANEL ASSY 869794 (-00, -05)
FRONT PANEL ASSY 869801 (-10, -15)
FIGURE 7-2

ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	869585	Panel Subassy, Front (-00, -05)	
1	869798	Panel Subassy, Front (-10, -15)	
2	128327	Lamp	DS-301
3	266063	Lampholder	
4	369636	Bracket, Switch	
5	269783	Bracket	
6	280278	Insulation	
7	269567	Switch, Sensitive	S-305, 306
8	5-115558-182	Resistor	R-303, 304, 305
9	264930	Switch, Pushbutton	S-301
10	269259	Switch, Pushbutton	S-303
11	269257	Switch, Pushbutton	S-307, 308
12	246552-1	Button, Push	
13	1-265849-4	Bracket	



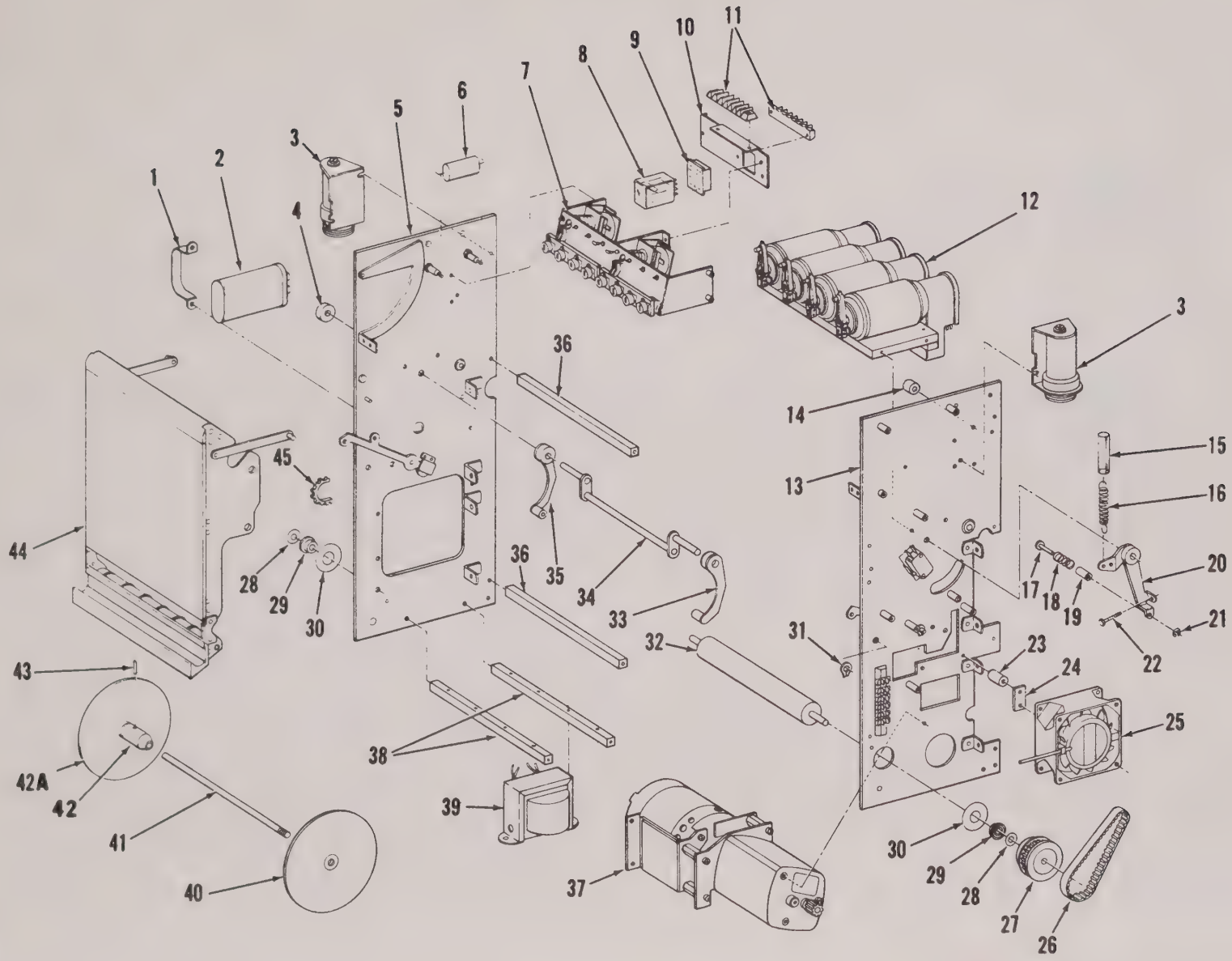
BRUSH 440 RECORDER ASM
FRONT PANEL ASM
FIGURE 7-2

EXPLODED VIEW PARTS LIST (Sheet 1 of 2)
CHASSIS ASSEMBLY 869819 (-00, -05)
CHASSIS ASSEMBLY 869878 (-10, -15)
FIGURE 7-3

ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	263394-1	Clamp, Capacitor	
2	1 263395 405	Capacitor (-00, -10)	C-305
2	1 263395-505	Capacitor (-05, 15)	C-305
3	766243	Ink Plunger Assy	
4	243443	Collar, Shaft	
5	869754	Plate Assy, LH-Fig. 7-8	
6	10-261998 824	Capacitor	C-306
7	869786	Manifold Assy -- Fig. 7-10	
8	269564	Relay, 4PDT	K-301
9	269574	Socket, Relay	
10	269691	Bracket	
11	265814-6	Terminal Board	TB-303, 304
12	869751	Penmotor Shield Assy (6347 series) Fig. 7-7	
12	880237	Penmotor Shield Assy (6337 series) Fig. 7-7	
13	869756	Plate Assy, RH - Fig. 7-9	
14	1 269579 1	Spacer, Threaded	
15	0 108400-25	Insulation	
16	1 240031 3	Spring, Helical	
17	643919 10	Disc Assy, Friction	
18	269291	Spring, Compression	
19	0 108400 15	Insulation, Sleeve	
20	743913-10	Arm Subassy, Brake	
21	0 240731 2	Washer, Retainer	
22	31 119924-6220	Screw, Mach. Hex Head	
23	1 269575 1	Spacer	
24	269721	Bracket, Fan	
25	286404 1	Fan (-00, 10)	
25	286404 2	Fan (-05, 15)	
26	262381 6	Belt, Timing	
27	61 234144 11	Pulley, Timing Belt	
28	127271	Washer	
29	265741 1	Bearing, Ball	
30	265745-1	Washer, Plain Mylar	
31	1 227070-9	Ring, Retaining	
32	669634	Roll, Drive	
33	769867	Arm, Sensor	
34	769865	Shaft, Sensor	
35	743915-10	Arm, Sensor	
36	269546	Spacer	
37	769785	Motor/Transmission Assy (-00) Fig. 7-6	

EXPLODED VIEW PARTS LIST (Sheet 2 of 2)
CHASSIS ASSEMBLY 869819 (-00, -05)
CHASSIS ASSEMBLY 869878 (-10, -15)
FIGURE 7-3

ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
37	780092	Motor/Transmission Assy (-05) Fig. 7-6	
37	769795	Motor/Transmission Assy (-10) Fig. 7-6	
37	780094	Motor/Transmission Assy (-15) Fig. 7-6	
38	269547	Spacer	
39	265542	Transformer	T-304 thru 304
40	769551	Hub Assy, Supply Roll, Right	
41	683281	Shaft Subassy, Supply	
42	243444	Hub, Supply Roll, Left	
42A	369542	Flange, Roll Supply	
43	3-119820-709	Pin, Grooved	
	769550	Shaft Assy (Includes 41, 42, 42A, 43)	
44	869745	Table Assy, Writing - Fig. 7-5	
45	1-128693-3	Grommet, Caterpillar	

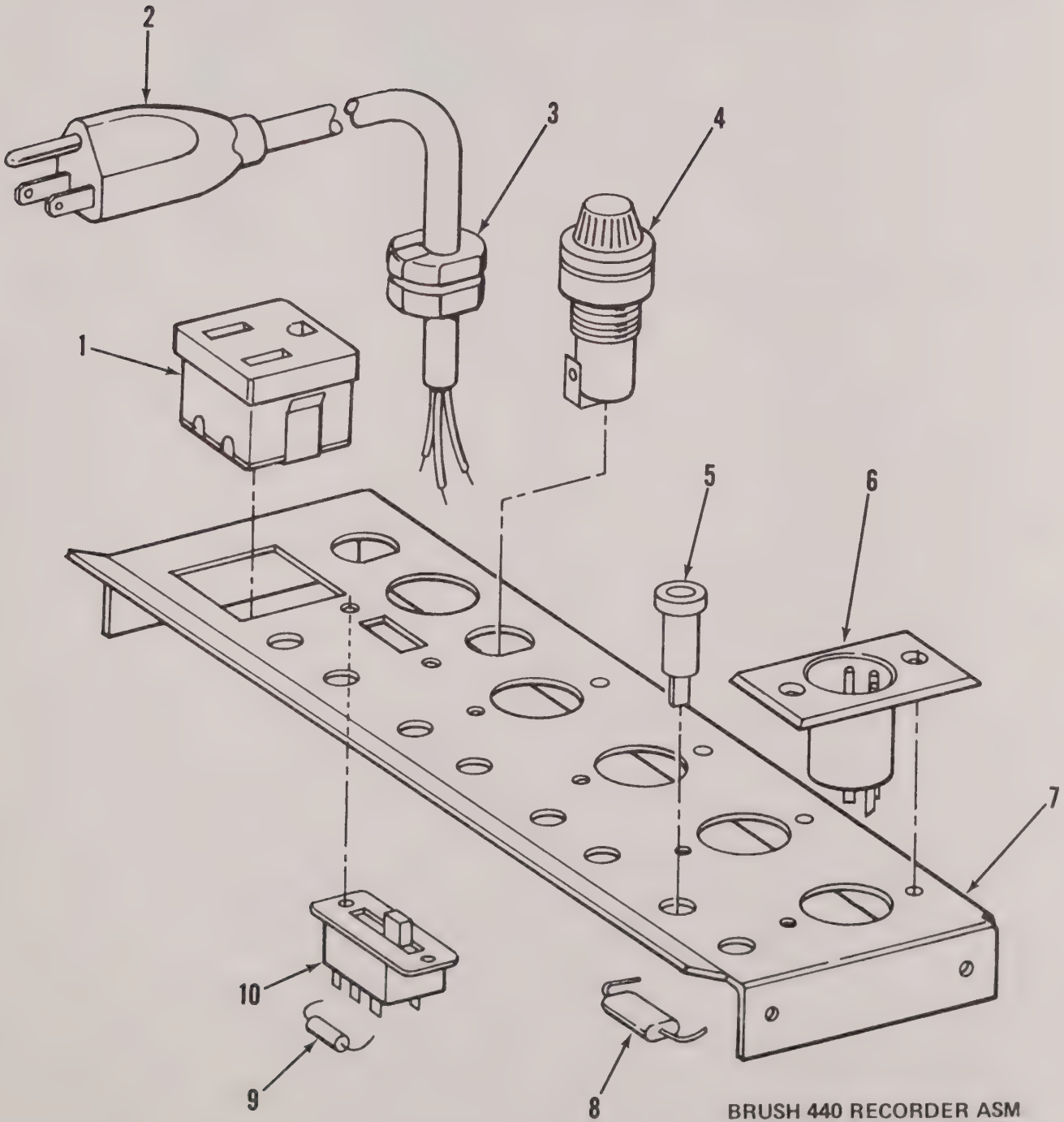


BRUSH 440 RECORDER ASM
CHASSIS ASSEMBLY
FIGURE 7-3

EXPLODED VIEW PARTS LIST
CONNECTOR BRACKET ASSY 869814 (6347 SERIES)
CONNECTOR BRACKET ASSY 880239 (6337 SERIES)
FIGURE 7-4

ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	244165	Connector, A-C	J-309
2	126295-7	Cable, 3-Conductor	P-302
3	108572-11	Bushing, Strain Relief	
4	129758	Fuse Holder	
5	265873-2	Jack, Banana	J-301 thru 308
6	234323	Connector, Receptacle	P-301-1 thru 301-4
*	2-113294-66	Button, Plug (6337 series)	
7	769742	Bracket Assy, Silkscreen	
8	10-241145-224	Capacitor, Fixed	C-301 thru C-304
9	5-115557-100	Resistor	R-306
10	240224	Switch, Slide	S-309

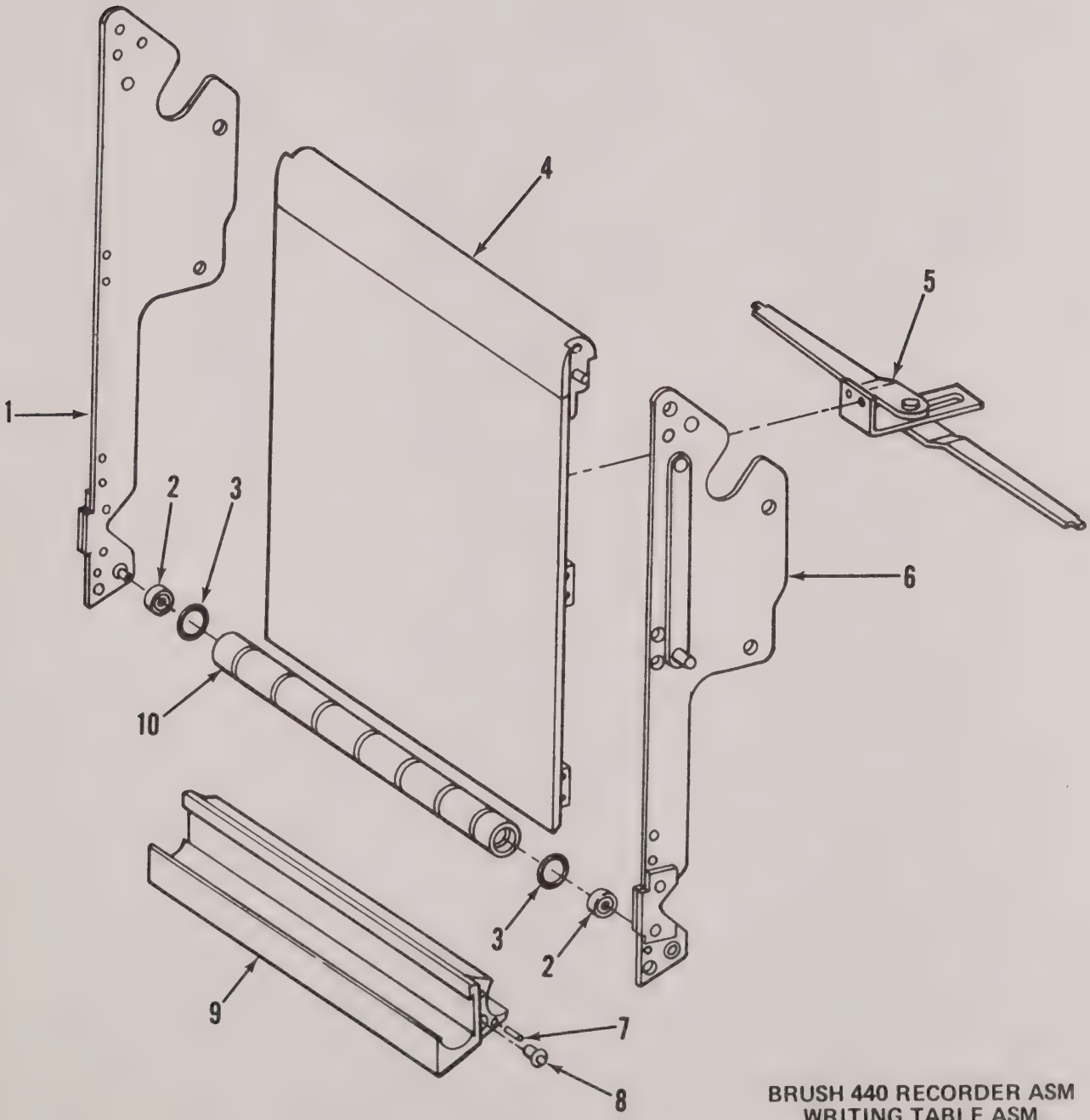
* Button used in place of one Item 6.



BRUSH 440 RECORDER ASM
CONNECTOR BRACKET ASM
FIGURE 7-4

EXPLODED VIEW PARTS LIST
WRITING TABLE ASSY 869745
FIGURE 7-5

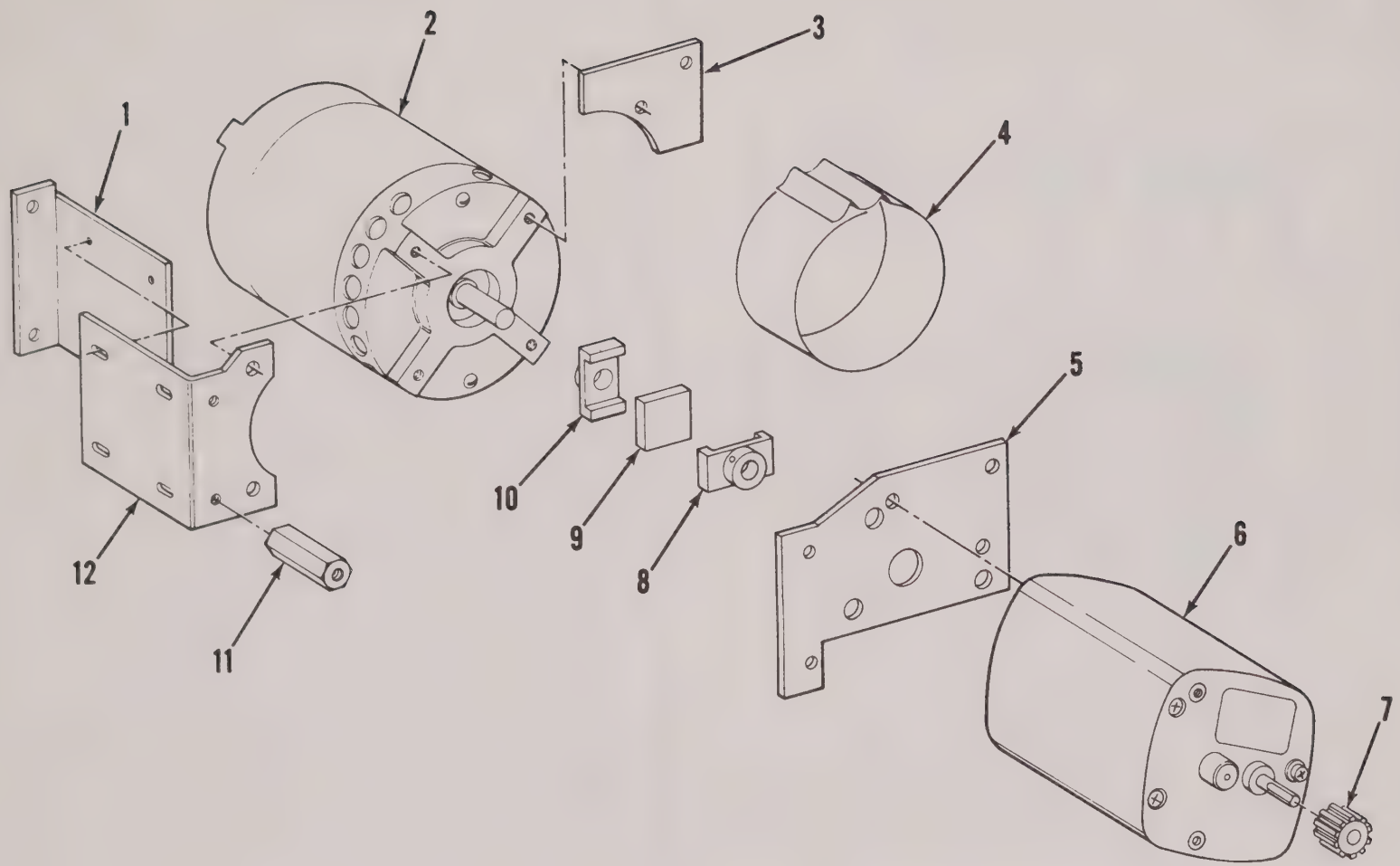
ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	769743	Support Assy, Writing Bar, Left	
2	1-210761-6	Bearing	
3	243867-1	Packing, Preformed	
4	869744	Table Subassy, Writing	
5	743807-10	Paper Release Assy	
6	769698	Support Assy, Writing Bar, Right	
7	4-112468-9	Roll Pin	
8	242217-5	Catch, Pin	
9	769635	Bar, Pull	
10	343620	Roll, Pressure	



BRUSH 440 RECORDER ASM
WRITING TABLE ASM
FIGURE 7-5

EXPLODED VIEW PARTS LIST
MOTOR/TRANSMISSION ASSY 769785 (-00)
MOTOR/TRANSMISSION ASSY 780092 (-05)
MOTOR/TRANSMISSION ASSY 769795 (-10)
MOTOR/TRANSMISSION ASSY 780094 (-15)
FIGURE 7-6

ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	269543	Bracket	
2	317713-2	Motor, Drive (-00, -10)	B-302
2	267590	Motor, Drive (-05, -15)	B-302
3	269544	Strap	
4	242164	Guard, Splash	
5	269545	Bracket (-00, -10)	
5	280085	Bracket (-05, -15)	
6	12-2154-08	Transmission Assy (-00, -05)	A-302
6	12-2156-08	Transmission Assy (-10, -15)	A-302
7	262627	Pulley, 10 Tooth (-00, -10)	
7	263920	Pulley, 12 Tooth (-05, -15)	
8	127913	Coupling, Universal	
9	123695	Core, Coupling	
10	127912	Coupling, Universal	
11	269548	Spacer	
12	369552	Bracket, Motor	



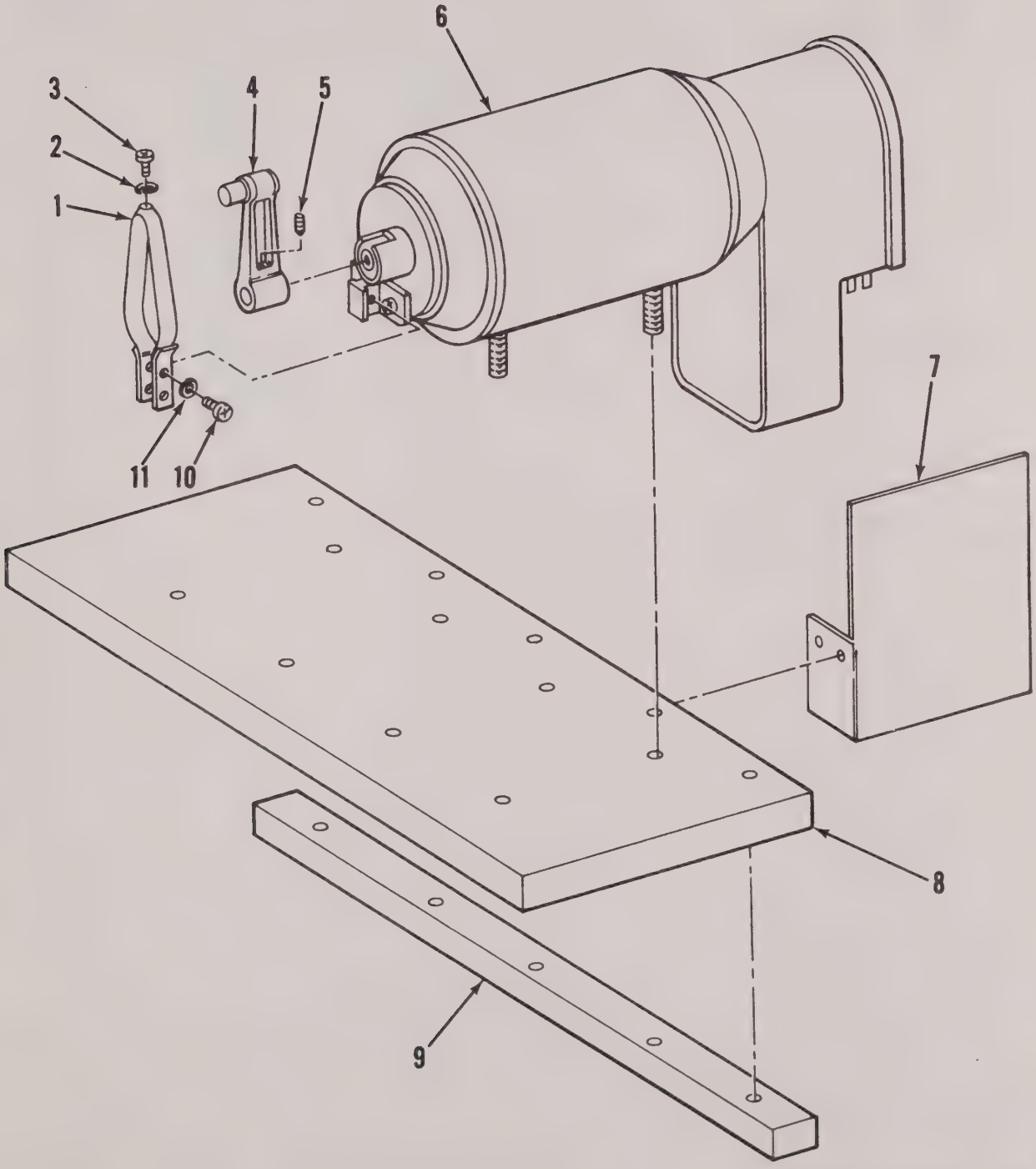
BRUSH 440 RECORDER ASM
MOTOR/TRANSMISSION ASM
FIGURE 7-6

EXPLODED VIEW PARTS LIST
PENMOTOR/SHIELD ASSY 869751 (6347 SERIES)
PENMOTOR/SHIELD ASSY 880237 (6337 SERIES)
FIGURE 7-7

ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	680294	Band Assy, Drive (40mm)	
1	242999-910	Band Assy, Drive (80mm)	
2	241227	Washer, Band Clamping (40mm)	
2	242925	Washer, Band Clamping (80mm)	
3	31-241908-0002	Screw, Cap	
4	767150	Drive Arm Assy (40mm)*	
4	Not Replaceable	Drive Arm Assy (80mm)	
5	31-121166-2602	Screw, Set (40mm)	
6	867060	Penmotor Assy, 40mm (includes item 1, 2, 3, 4, 5, 10, 11)	
6	880221	Penmotor Assy, 80mm (includes item 1, 2, 3, 4, 5, 10, 11)	
7	266871	Shield	
8	780035	Bar, Penmotor Mtg (6347 series)	
8	780228	Bar, Penmotor Mtg (6337 series)	
9	269820	Bar, Stiffener (6347 series)	
10	31-119922-2602	Screw, Socket	
11	11305-37	Washer	

NOTE: To repair or replace penmotor parts not shown, entire penmotor assembly must be ordered.

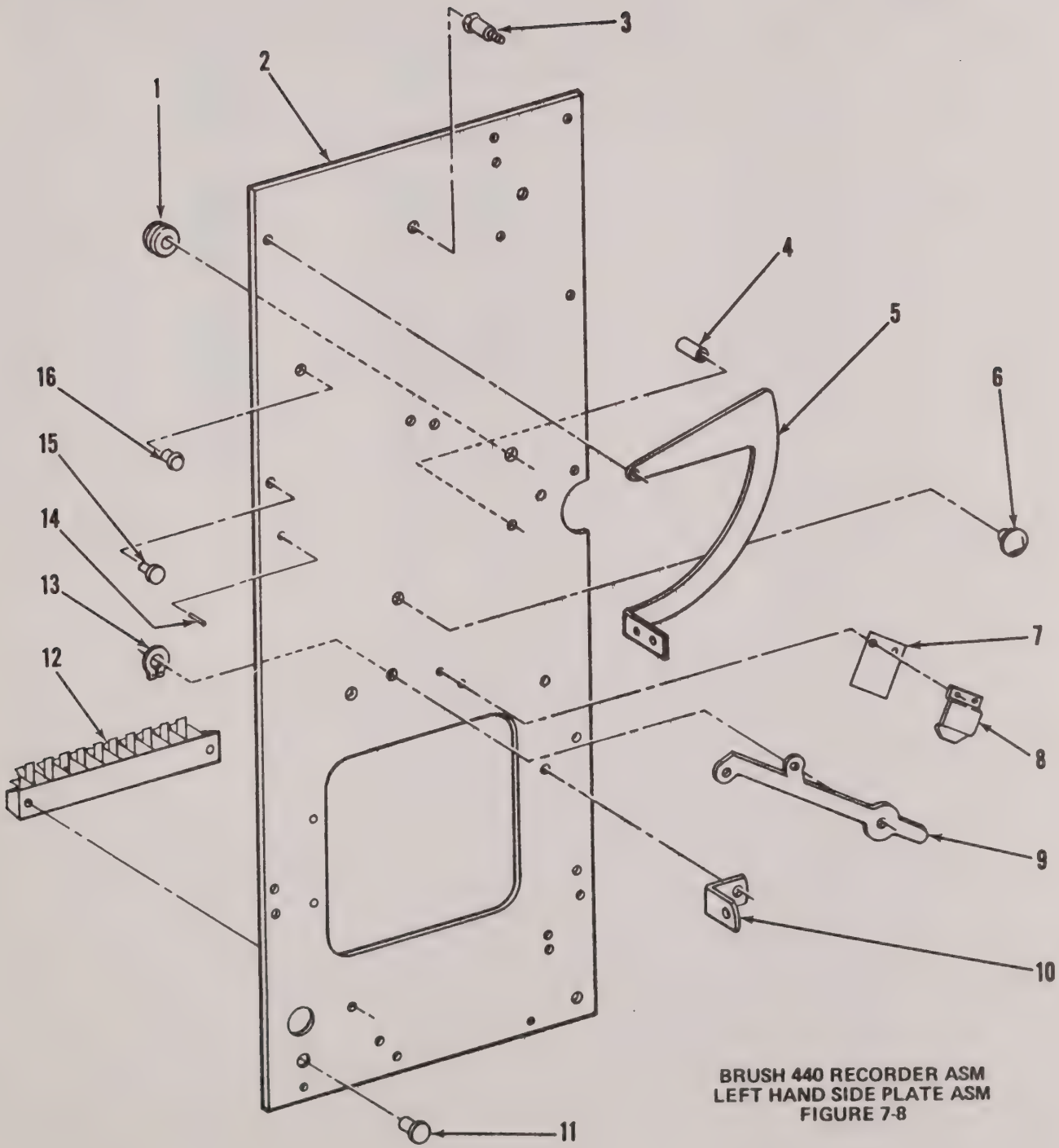
* This part should only be replaced by an authorized Brush Service Representative.



BRUSH 440 RECORDER ASM
PENMOTOR/SHIELD ASM
FIGURE 7-7

EXPLODED VIEW PARTS LIST
LEFT HAND SIDE PLATE ASSY 869754
FIGURE 7-8

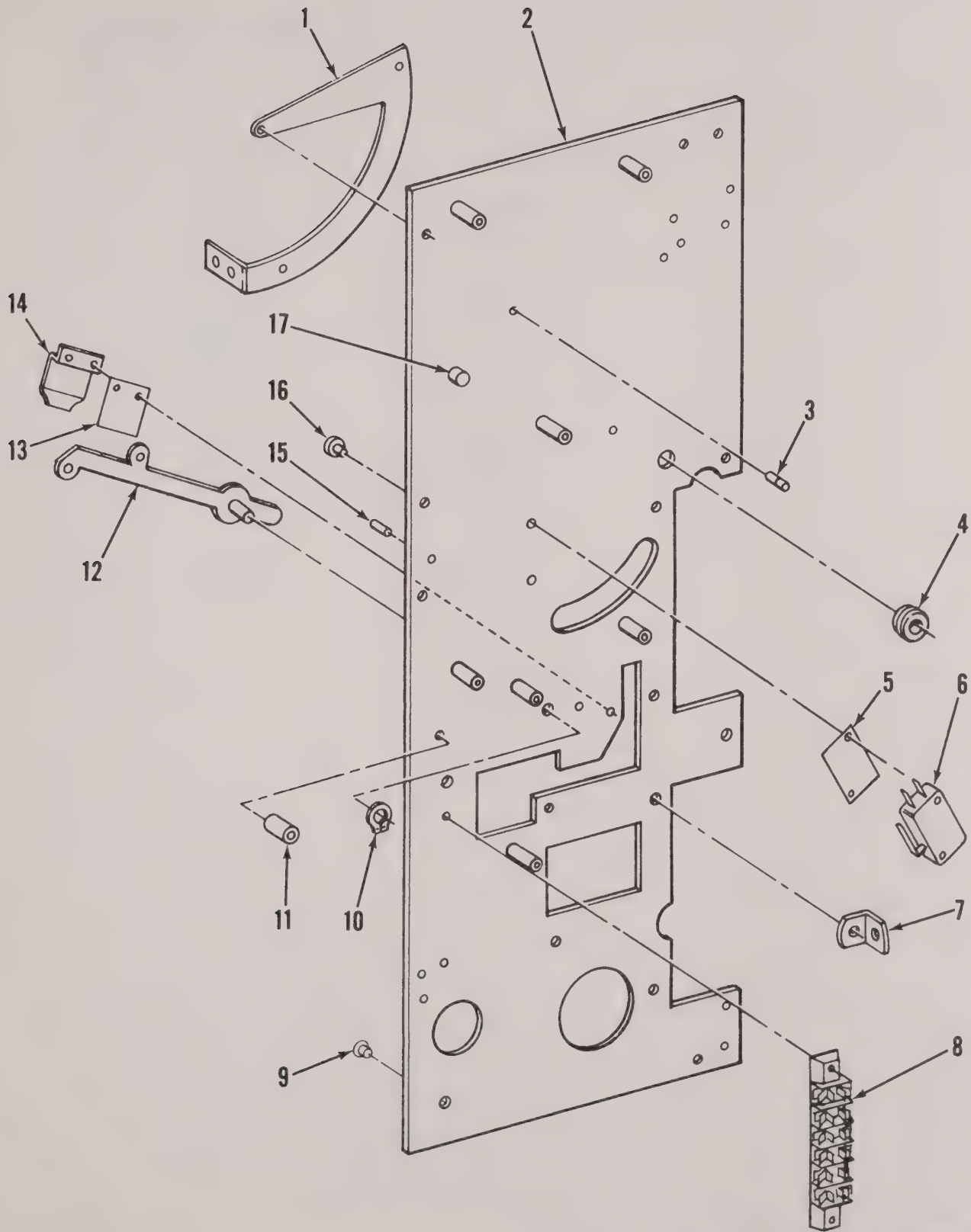
ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	123108-44	Grommet	
2	869582	Plate Subassy, Side LH	
3	1-123295-8	Terminal, Stud-Insulated	
4	269948	Spacer, Insulated	
5	267464	Hinge, LH	
6	243440	Bumper	
7	243622	Pad, Friction	
8	243623	Spring, Positioning	
9	243611-910	Lever Assy, LH	
10	669792	Bracket Assy	
11	265711	Catch	
12	265814-10	Terminal Board	TB-301
13	1-227070-9	Ring, Retaining-Grip	
14	240161-310	Pin, Roll	
15	267479	Button	
16	242217-5	Catch, Ball	



BRUSH 440 RECORDER ASM
LEFT HAND SIDE PLATE ASM
FIGURE 7-8

EXPLODED VIEW PARTS LIST
RIGHT HAND SIDE PLATE ASM 869756
FIGURE 7-9

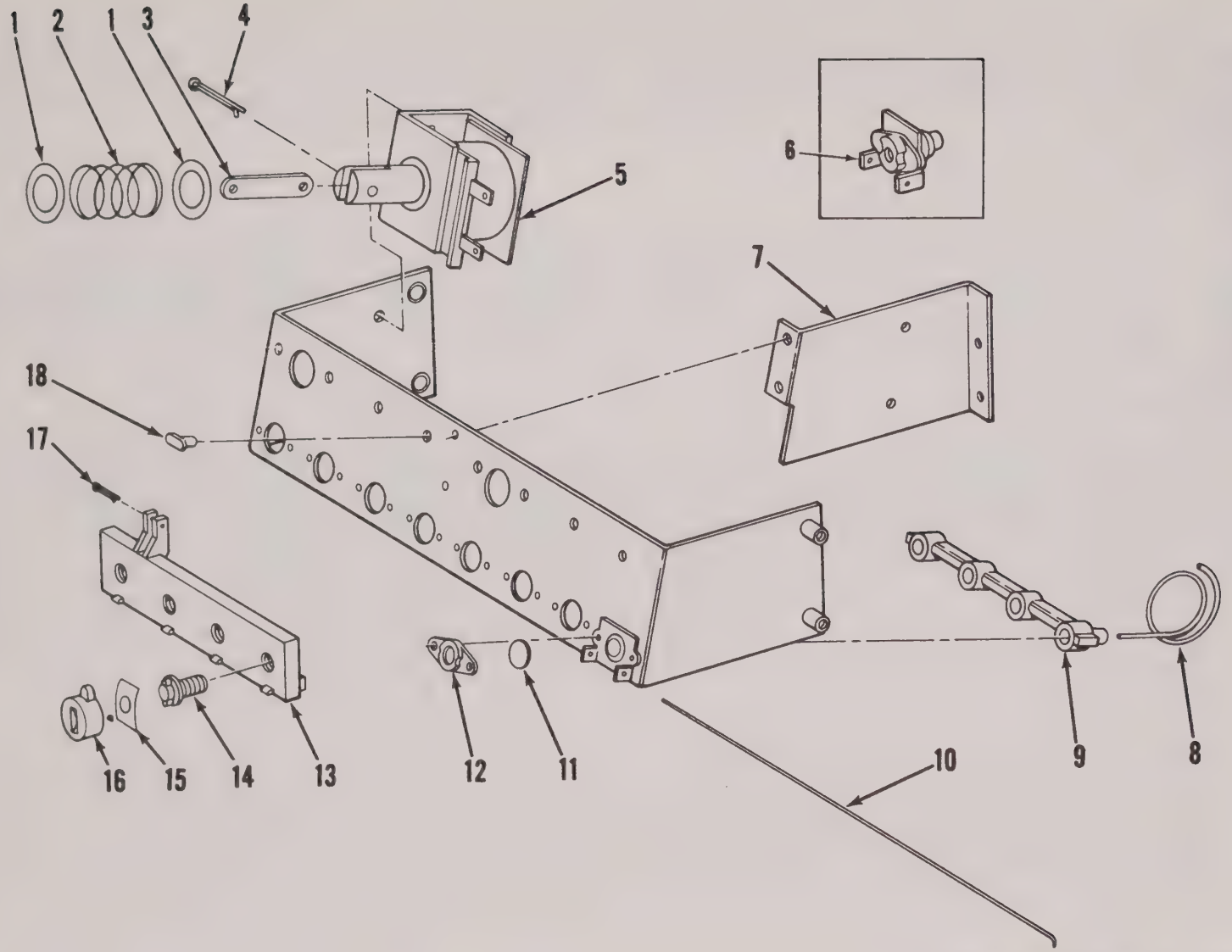
ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	267466	Hinge, RH	
2	869584	Plate Subassy, Side RH	
3	265874-1	Pin	
4	123108-44	Grommet	
5	243998	Insulator, Micro-Switch	
6	266326	Switch, Sensitive	S-305
7	1-265849-4	Bracket, Angle	
8	265814-6	Terminal Board	TB-302
9	265711	Catch	
10	1-227070-9	Ring, Retaining-Grip	
11	269948	Spacer, Insulated	
12	665789	Lever Assy, RH	
13	243622	Pad, Friction	
14	243623	Spring, Positioning	
15	240161-310	Pin, Roll	
16	267479	Button	
17	242217-5	Catch, Ball	



BRUSH 440 RECORDER ASM
RIGHT HAND SIDE PLATE ASM
FIGURE 7-9

EXPLODED VIEW PARTS LIST
MANIFOLD ASSY 869786
FIGURE 7-10

ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	269805	Washer	
2	269549	Spring, Compression	
3	265990	Link, Connecting	
4	236865-3	Cotter Pin	
5	266888	Solenoid	L-301, L-302
6	684169	Valve Assembly	
7	269590	Bracket, Support	
8	666582	Tube	
9	680141	Supply Manifold	
10	280142	Shaft	
11	267858	Diaphragm	
12	467355-2	Retainer, Diaphragm	
13	680143	Lever, Operator	
14	467355-5	Screw, Operator	
15	269683	Spring	
16	467355-6	Knob, Ink Control	
17	236865-2	Cotter Pin	
18	249360	Cap, Ink Outlet	



BRUSH 440 RECORDER ASM
MANIFOLD ASM
FIGURE 7-10

BRUSH 440 RECORDER
ALL MODELS—EXPLODED VIEW
NETWORK,DRIVE AMPLIFIER 869223
FIGURE 7-11

SYMBOL NO	PART NUMBER	DESCRIPTION
A-201	269062	Oscillator Module
C-201	231922-106	Capacitor
C-202	10-125904-203	Capacitor
C-203	243037-108	Capacitor
C 204*	10-241145-333	Capacitor
C 204	10-247116-333	Capacitor
C-205	269255-107	Capacitor
C-206	240352-101	Capacitor
C 207	243037-108	Capacitor
C-208*	10-241145-163	Capacitor
C 208	10-247116-153	Capacitor
C-209	241513-506	Capacitor
CR 201	244311	Semiconductor, Diode
CR 202	231869	Semiconductor, Diode
CR 203	244311	Semiconductor, Diode
CR-204	244311	Semiconductor, Diode
CR 205	231869	Semiconductor, Diode
CR 206	244311	Semiconductor, Diode
CR 207	231869	Semiconductor, Diode
CR 208	241133	Semiconductor, Diode
CR 209	5 244922-20	Semiconductor, Diode
CR 210	5 244922 20	Semiconductor, Diode
CR 211	244311	Semiconductor, Diode
CR 212	231869	Semiconductor, Diode
CR 213	231869	Semiconductor, Diode
CR 214	244311	Semiconductor, Diode
CR 215	265420-2	Rectifier, Bridge
CR 216	231887	Semiconductor, Diode
CR 217	269256-7	Semiconductor, Diode
CR 218	231887	Semiconductor, Diode
CR-219	231887	Semiconductor, Diode
CR 220	231887	Semiconductor, Diode
F 201	116198-7	Fuse
F-202	116198 7	Fuse
IC 201 *	230062	Semiconductor, IC
IC 201	230062-1	Semiconductor, IC
L-201	263453 1	Coil
L 202	263453 1	Coil
Q 201	230057-2	Transistor, 2N4922
Q 202	240236	Transistor, 2N1303
Q 203	240237	Transistor, 2N1302
Q 204	242323	Transistor
Q-205	240237	Transistor, 2N1302

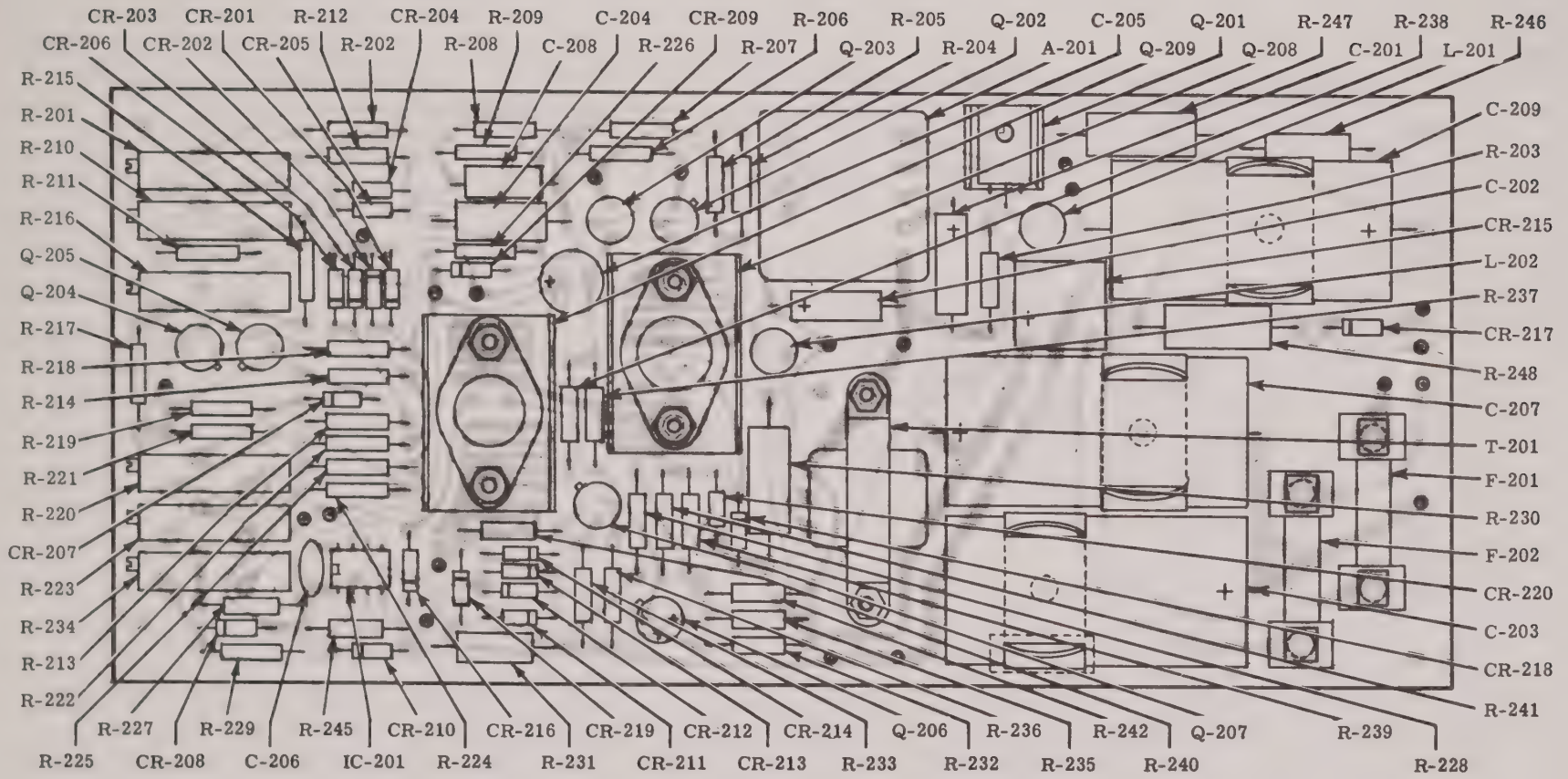
*Used on Assembly 869223, schematic 269587, Rev. D-1 (not shown)

BRUSH 440 RECORDER
ALL MODELS – EXPLODED VIEW
NETWORK DRIVE AMPLIFIER 869223 (continued)
FIGURE 7-11

SYMBOL NO	PART NUMBER	DESCRIPTION
Q-206	242323	Transistor
Q-207	247149	Transistor
Q-208	267718-3	Transistor, 2N4900
Q-209	267716-3	Transistor, 2N4912
R-201	244771-502	Resistor, Variable
R-202	1-128182-3601	Resistor
R-203	5-115557-151	Resistor
R-204	5-115557-103	Resistor
R-205	5-115557-103	Resistor
R-206	1-128182-1502	Resistor
R-207	1-128182-1502	Resistor
R-208	1-128182-4701	Resistor
R-209	1-128182-2501	Resistor
R-210	244771-502	Resistor, Variable
R-211	1-128182-6801	Resistor
R-212	1-128182-91671	Resistor
R-213	1-128182-1103	Resistor
R-214	5-115557-822	Resistor
R-215	1-128182-1501	Resistor
R-216	244771-202	Resistor, Variable
R-217	1-128182-1501	Resistor
R-218	1-128182-5002	Resistor
R-219	1-128182-3901	Resistor
R-220	244771-202	Resistor, Variable
R-221	1-128182-2501	Resistor
R-222	1-128182-5601	Resistor
R-223	244771-502	Resistor, Variable
R-224	1-128182-5601	Resistor
R-225	1-128182-1103	Resistor
R-226	1-128182-2702	Resistor
R-227	5-115557-273	Resistor
R-228	1-128182-5003	Resistor
R-229	1-128182-5002	Resistor
R-230	5-115558-181	Resistor
R-231	5-115558-271	Resistor
R-232	5-115557-183	Resistor
R-233	5-115557-183	Resistor
R-234	244771-103	Resistor, Variable
R-235	5-115557-471	Resistor
R-236	5-115557-471	Resistor
R-237	5-115557-471	Resistor
R-238	5-115557-471	Resistor
R-239	5-115557-332	Resistor
R-240	5-115557-332	Resistor

BRUSH 440 RECORDER
ALL MODELS – EXPLODED VIEW
NETWORK DRIVE AMPLIFIER 869223 (continued)
FIGURE 7-11

SYMBOL NO	PART NUMBER	DESCRIPTION
R-241	5-115557-103	Resistor
R-242	5-115557-122	Resistor
R-243	Not Used	
R-244	Not Used	
R-245	5-115557-102	Resistor
R-246	5-115558-220	Resistor
R-247	5-115559-152	Resistor
R-248	5-115559-152	Resistor
T-201	263516	Transformer



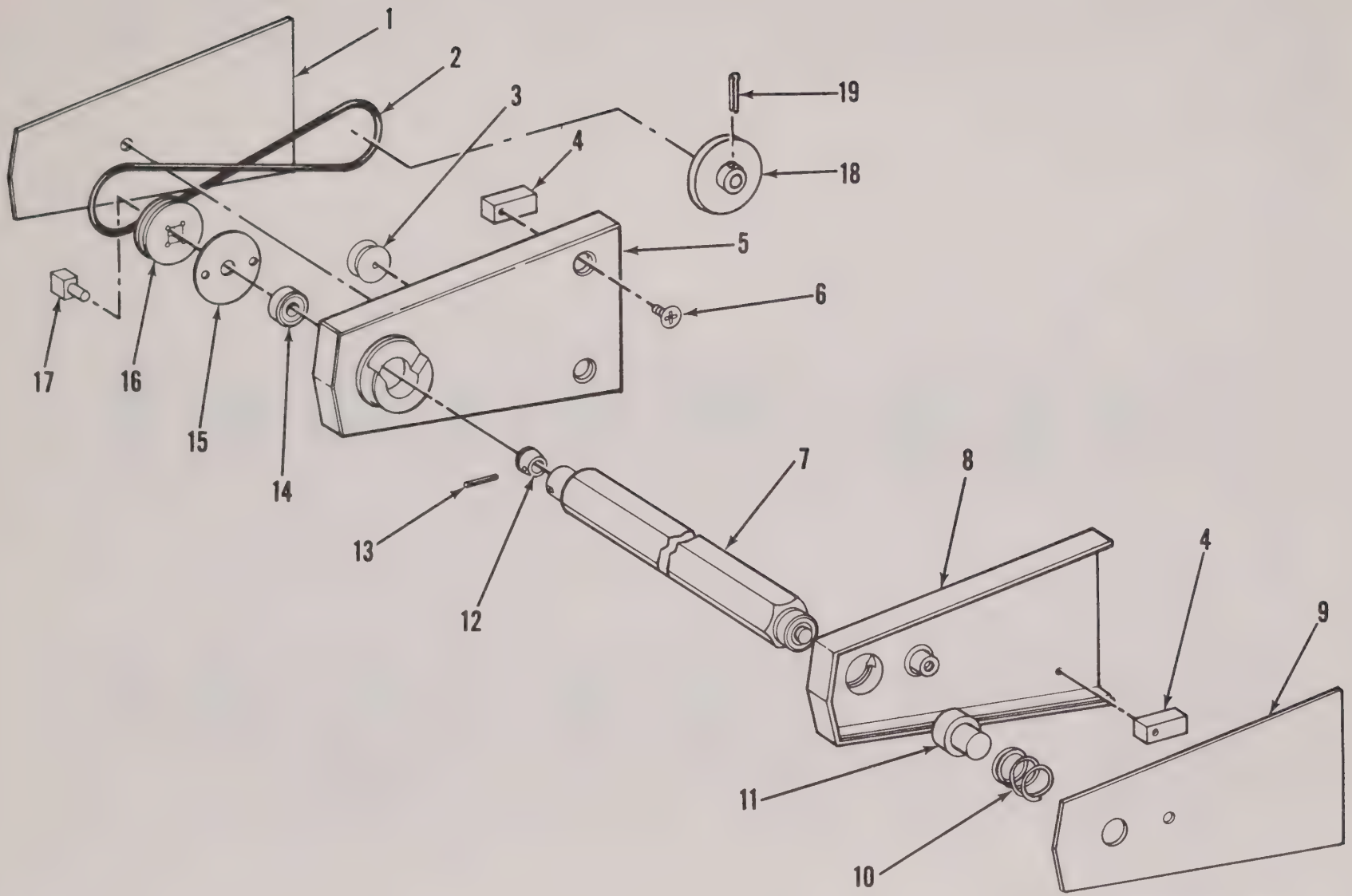
DRIVE NETWORK ASSY 869223

BRUSH 440
NETWORK ASSEMBLY
FIG. 7-11

EXPLODED VIEW PARTS LIST
CHART TAKE-UP ASSY 11-6402-05
FIGURE 7-12

ITEM NO.	PART NUMBER	DESCRIPTION	SYMBOL NO.
1	249617-1	Plate Cover-Right	
2	243867-9*	O-Ring	
3	246651	Roller Guide	
4	246307	Block	
5	767254-3	Arm Assy, LH	
6	3-249640-8206	Screw, Flat Head	
7	643864-10	Shaft Assy – (Includes bearing no. 230069-1)	
8	767249-3	Arm, Right	
9	249618-1	Plate Cover, Left	
10	267253	Spring, Compression	
11	266184	Shaft, Shoulder	
12	243740	Collar	
13	4-112468-14	Pin, Roll	
14	1-210761-1	Bearing	
15	243696	Retainer Bearing	
16	267257	Pulley	
17	266053	Shaft	
18	266046	Pulley	
19	236865-3	Pin, Cotter	

*For top mounted Chart Takeups, use part number 243867-5



BRUSH 440 RECORDER ASM
CHART TAKE-UP ASM
FIGURE 7-12

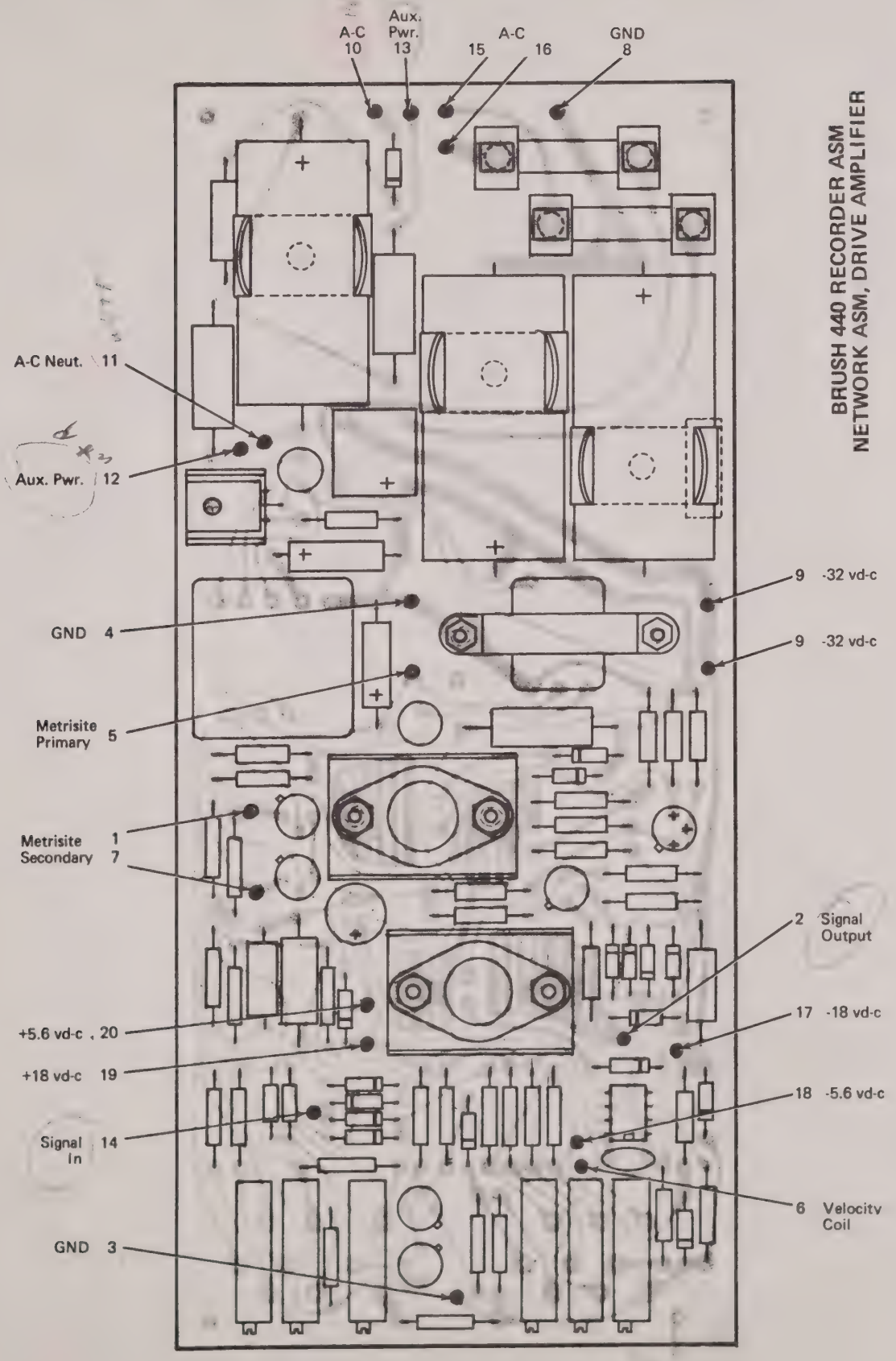
ELECTRICAL PARTS LIST
BRUSH 440 RECORDER

SYMBOL NO	PART NUMBER	DESCRIPTION
A-302	12-2154-08	Transmission (-00, -05 only)
A-302	12-2156-08	Transmission (-10, -15 only)
B-302	317713-2	Motor, Chart Drive (-00. -10 only)
B-302	267590	Motor, Chart Drive (-05, -15 only)
C-301	10-241145-224	Capacitor
C-302	10-241145-224	Capacitor
C-303	10-241145-224	Capacitor
C-304	10-241145-224	Capacitor
C-305	1-263395-505	Capacitor (-05, -15 only)
C-305	1-263395-405	Capacitor (-00, -10)
C-306	10-261998-824	Capacitor
DS-301	128327	Lamp
F-301	116198-13	Fuse, 3 Amp Slo Blo
F-302	116198-11	Fuse, 1½ Amp Slo-Blo
J-301	265873-2	Receptacle
J-302	265873-2	Receptacle
J-303	265873-2	Receptacle
J-304	265873-2	Receptacle
J-305	265873-2	Receptacle
J-306	265873-2	Receptacle
J-307	265873-2	Receptacle
J-308	265873-2	Receptacle
J-309	244165	Receptacle, A-C
K-301	269546	Relay
L-301	266888	Solenoid
L-302	266888	Solenoid
M-301	880221	Penmotor (80mm)
M-301	867060	Penmotor (40mm)
M-302	867060	Penmotor (40mm)
M-303	867060	Penmotor (40mm)
M-304	867060	Penmotor (40mm)
P-301-1	234323	Connector
P-301-2	234323	Connector
P-301-3	234323	Connector
P-301-4	234323	Connector
P-302	126295-7	Cable, Power Input
R-303	5-115558-182	Resistor
R-304	5-115558-182	Resistor
R-305	5-115558-182	Resistor

ELECTRICAL PARTS LIST (Continued)
BRUSH 440 RECORDER

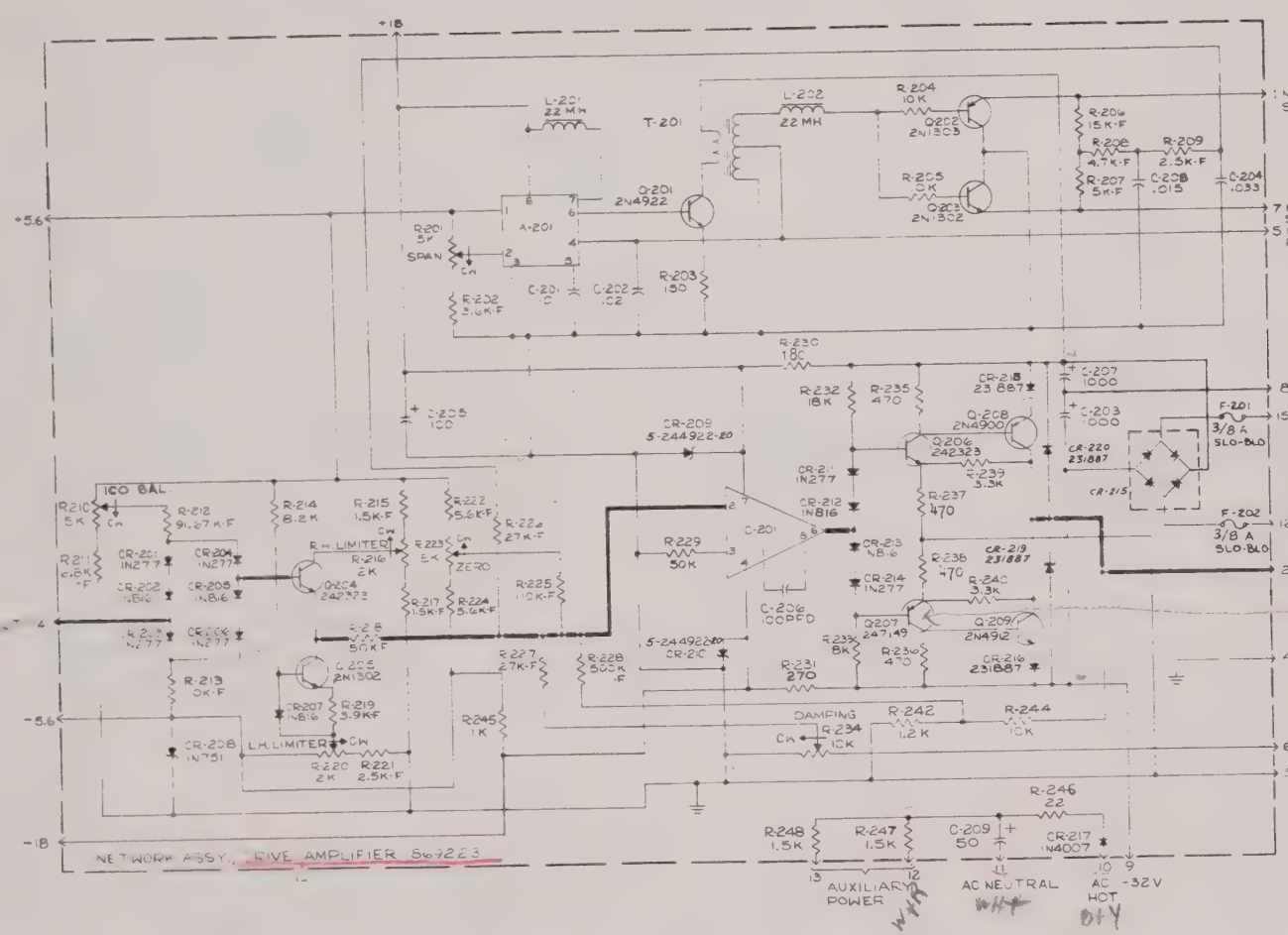
SYMBOL NO	PART NUMBER	DESCRIPTION
S-301	264930	Switch (includes S-302)
S-302	Part of S-301	Switch
S-303	269259	Switch
S-304	269567	Switch
S-305	266326	Switch
S-306	269567	Switch
S-307	269257	Switch
S-308	269257	Switch
S-309	240224	Switch
T-301	265542	Transformer
T-302	265542	Transformer
T-303	265542	Transformer
T-304	265542	Transformer
TB-301	265814-10	Terminal Board
TB-302	265814-6	Terminal Board
TB-303	265814-6	Terminal Board
TB-304	265814-6	Terminal Board

BRUSH 440 RECORDER ASM
NETWORK ASM, DRIVE AMPLIFIER



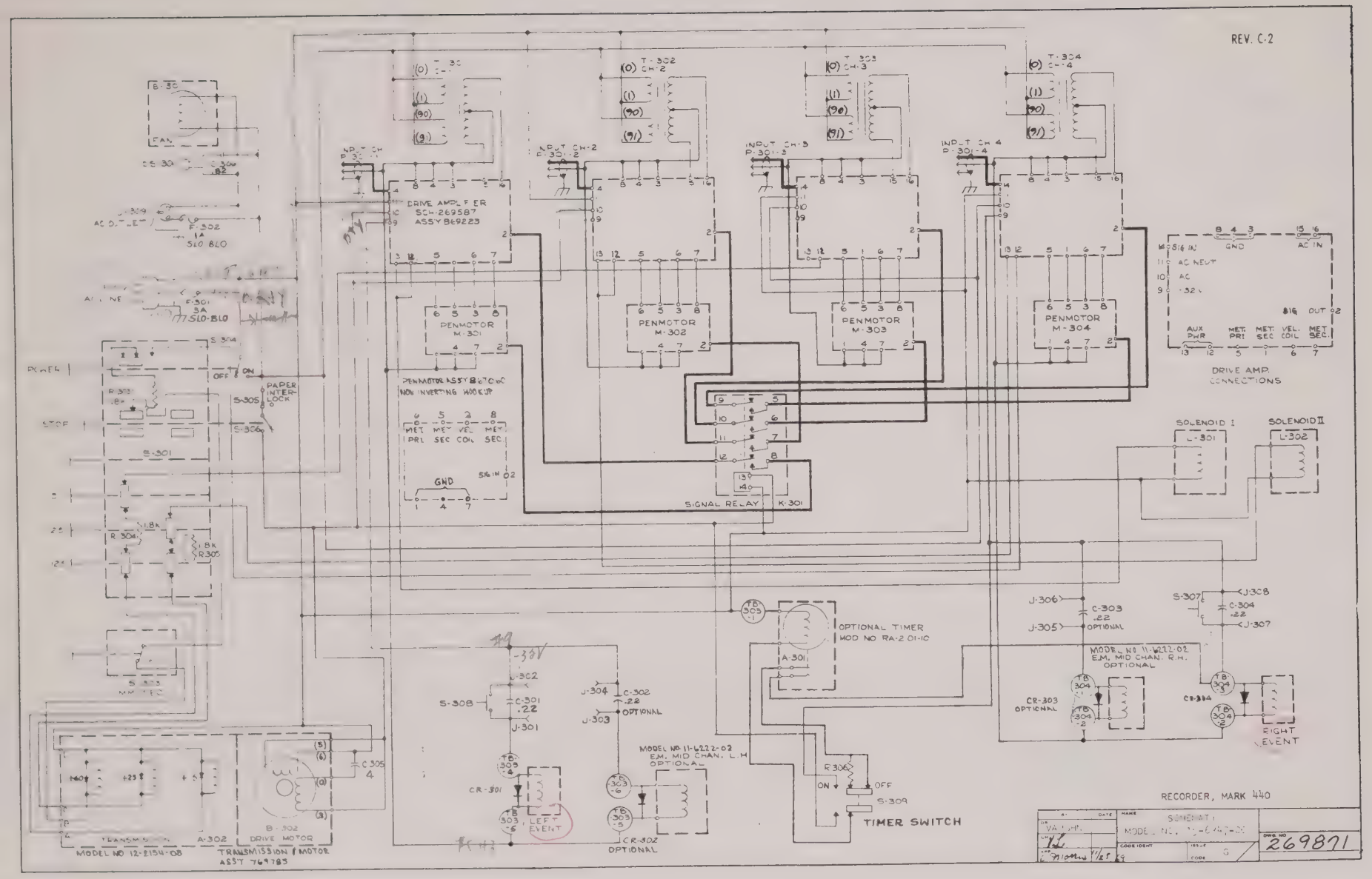
The numbers and voltages on this page refer to the numbers and voltages on schematic 269587.

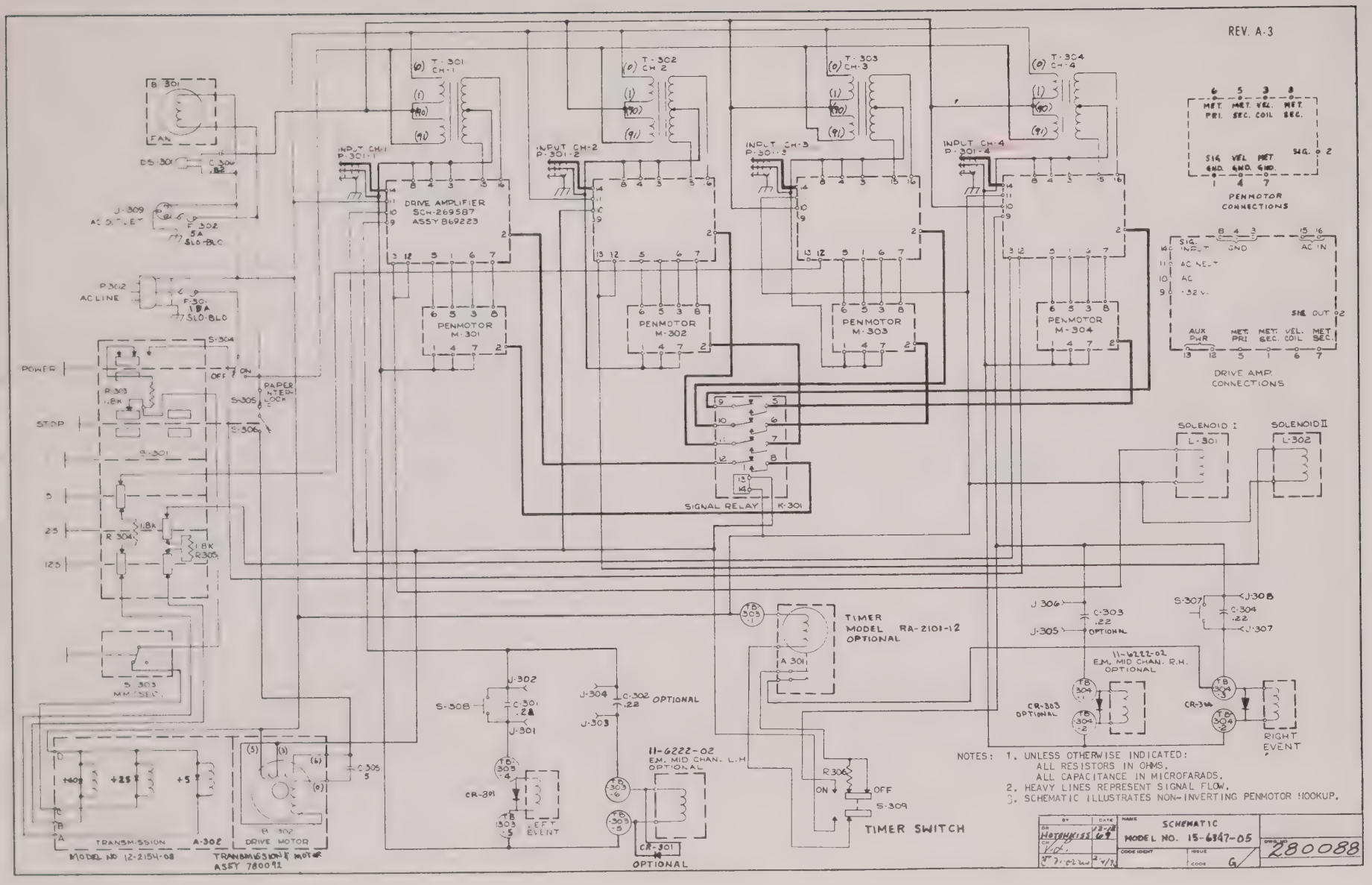
REV H-1

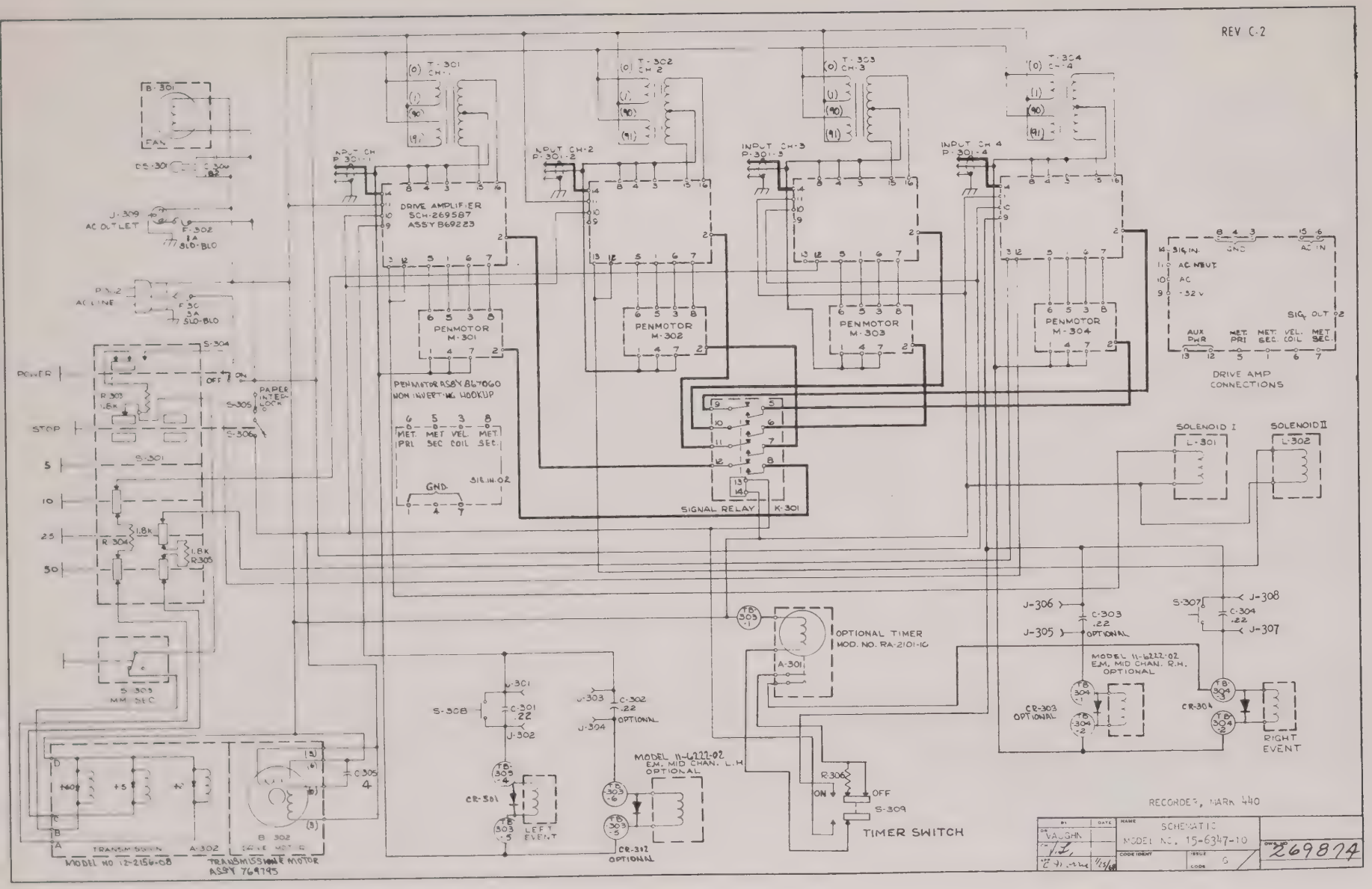


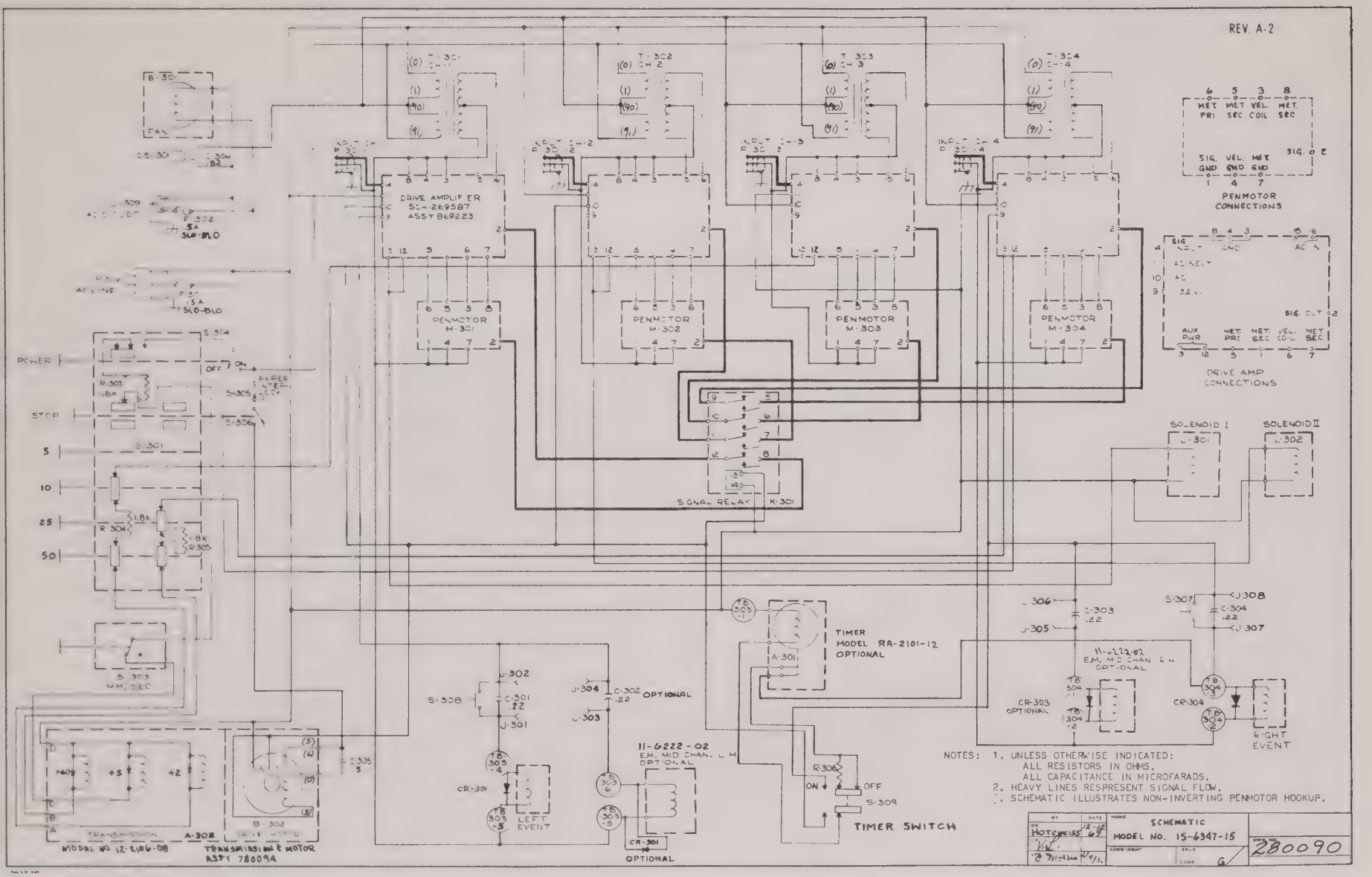
Replaced in two amplifiers HEP. 5 1

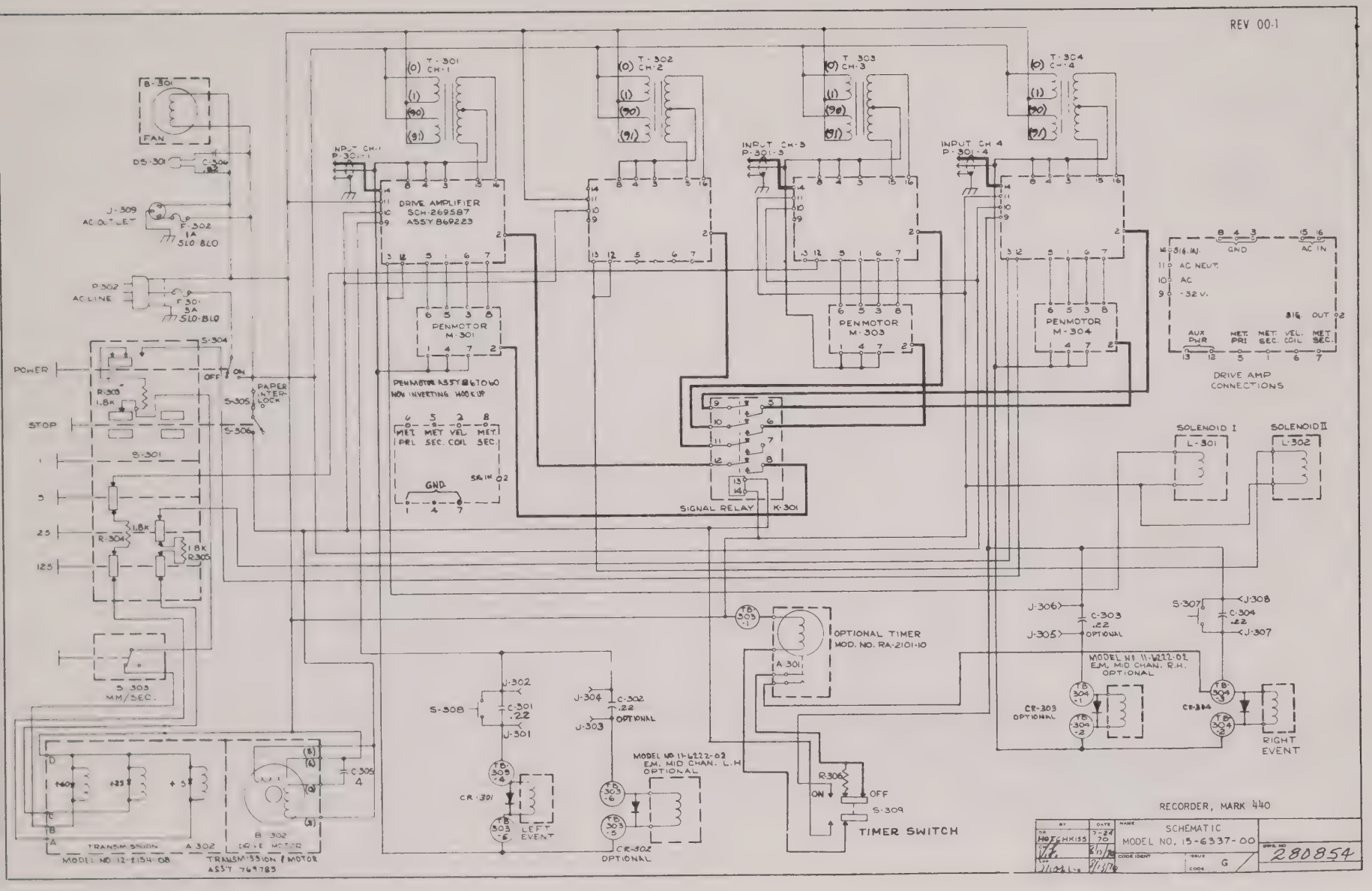
BY	DATE	NAME	SCHEMATIC
DR SALVATORE/			ASSEMBLY NO. 869223
CH V.L.	8/20/60	COLOR IDENT	ISSUE G
ENG E.J.W.	8/20/60	CODE	DWG NO 269587

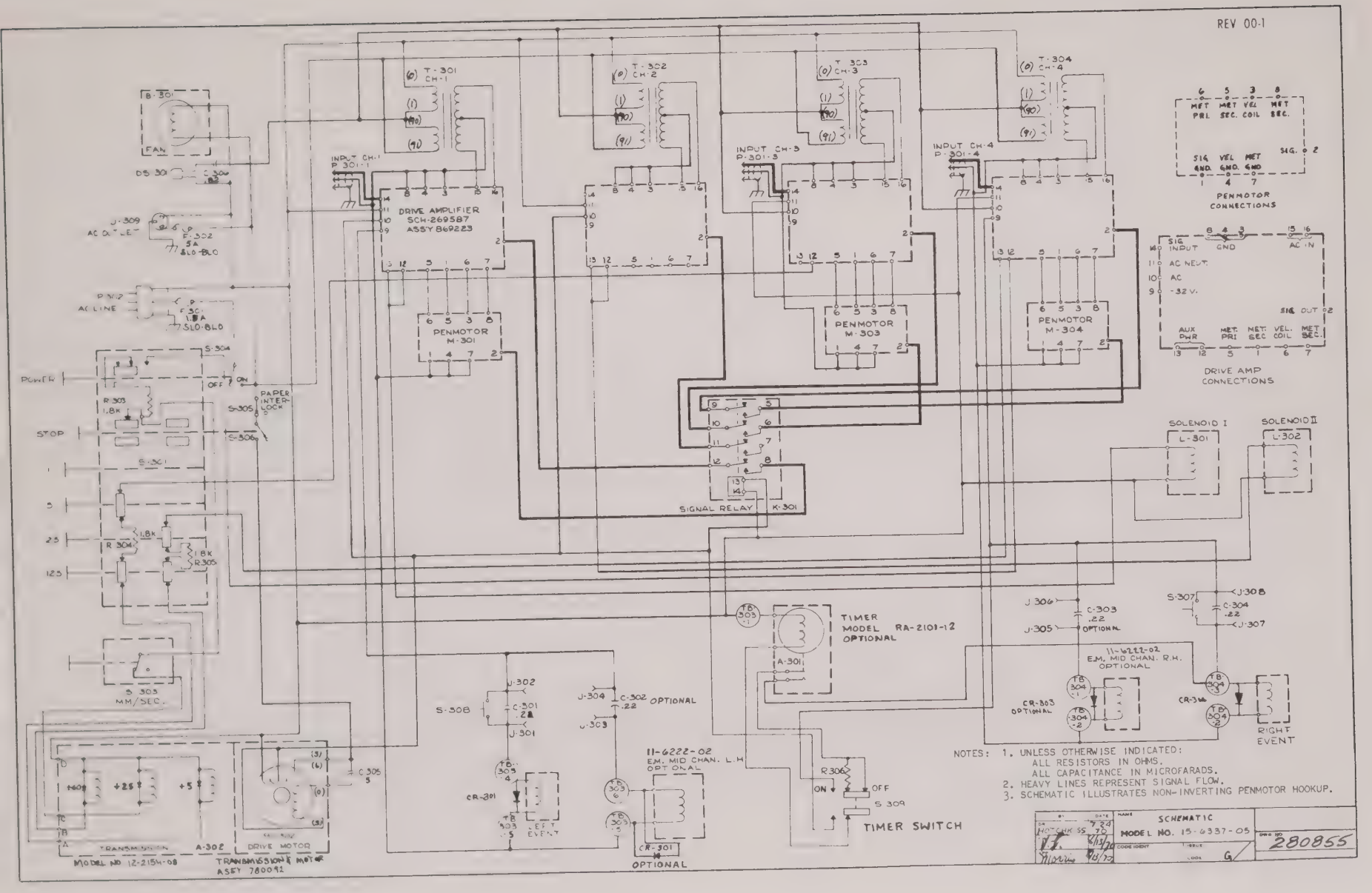

REV. C-2
DRIVE AMPLIFIER SCH-269587 ASSY B69223
PENMOTOR M-301
PENMOTOR M-302
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR ASSY 867006 NON INVERTING HOOKUP
DRIVE AMP. CONNECTIONS
SIGNAL RELAY K-301
SOLENOID I L-301
SOLENOID II L-302
OPTIONAL TIMER MOD NO RA-201-10
MODEL NO 11-6222-02 E.M. MID CHAN. L.H. OPTIONAL
MODEL NO 11-6222-02 E.M. MID CHAN. R.H. OPTIONAL
TIMER SWITCH
RECORDER, MARK 440
MODEL NO 12-2154-08
TRANSMISSION / MOTOR ASS'T 769785
269871

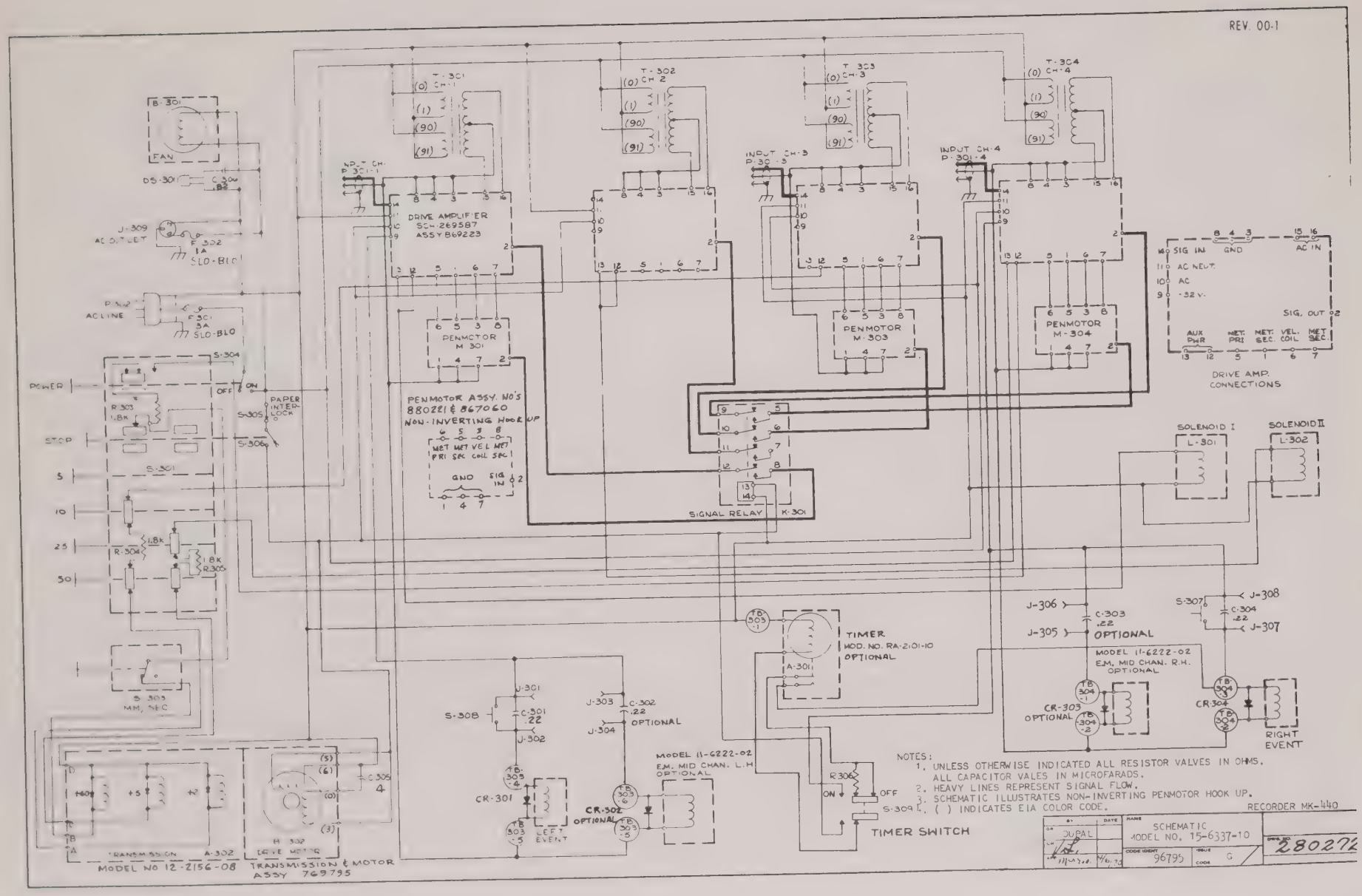

REV. A-3
T-301 CH-1
T-302 CH-2
T-303 CH-3
T-304 CH-4
INPUT CH-1 P-301-1
INPUT CH-2 P-301-2
INPUT CH-3 P-301-3
INPUT CH-4 P-301-4
DRIVE AMPLIFIER SCH-269587 ASSY 869223
PENMOTOR M-301
PENMOTOR M-302
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
DRIVE AMP. CONNECTIONS
B-301 FAN
DS-301
J-309 AC OUTLET
F-302 5A SLO-BLO
P-302 AC LINE
F-301 1.8A SLO-BLO
S-304 POWER OFF ON
R-303 1.8K
S-305 PAPER INTERLOCK
S-306 STOP
S-301
R-304 1.8K
R-305 1.8K
0
25
125
S-303 MM SEL.
SIGNAL RELAY K-301
SOLENOID I L-301
SOLENOID II L-302
TIMER MODEL RA-2101-12 OPTIONAL
A-301
J-306
C-303 .22 OPTIONAL
J-305
S-307
J-308
C-304 .22
J-307
11-6222-02 EM. MID CHAN. R.H. OPTIONAL
CR-303 OPTIONAL
CR-304
RIGHT EVENT
J-302
S-308
C-301 .22
J-301
J-304
C-302 .22 OPTIONAL
J-303
11-6222-02 EM. MID CHAN. L.H. OPTIONAL
CR-301
LEFT EVENT
R-306
ON
OFF
S-309
TIMER SWITCH
+60
+25
+5
C-305 5
TRANSMISSION A-302
MODEL NO 12-2154-08
R-302 DRIVE MOTOR
TRANSMISSION MOTOR ASSY 780092
OPTIONAL
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS,
ALL CAPACITANCE IN MICROFARADS,
2. HEAVY LINES REPRESENT SIGNAL FLOW,
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6347-05
HOTCHKISS
280088

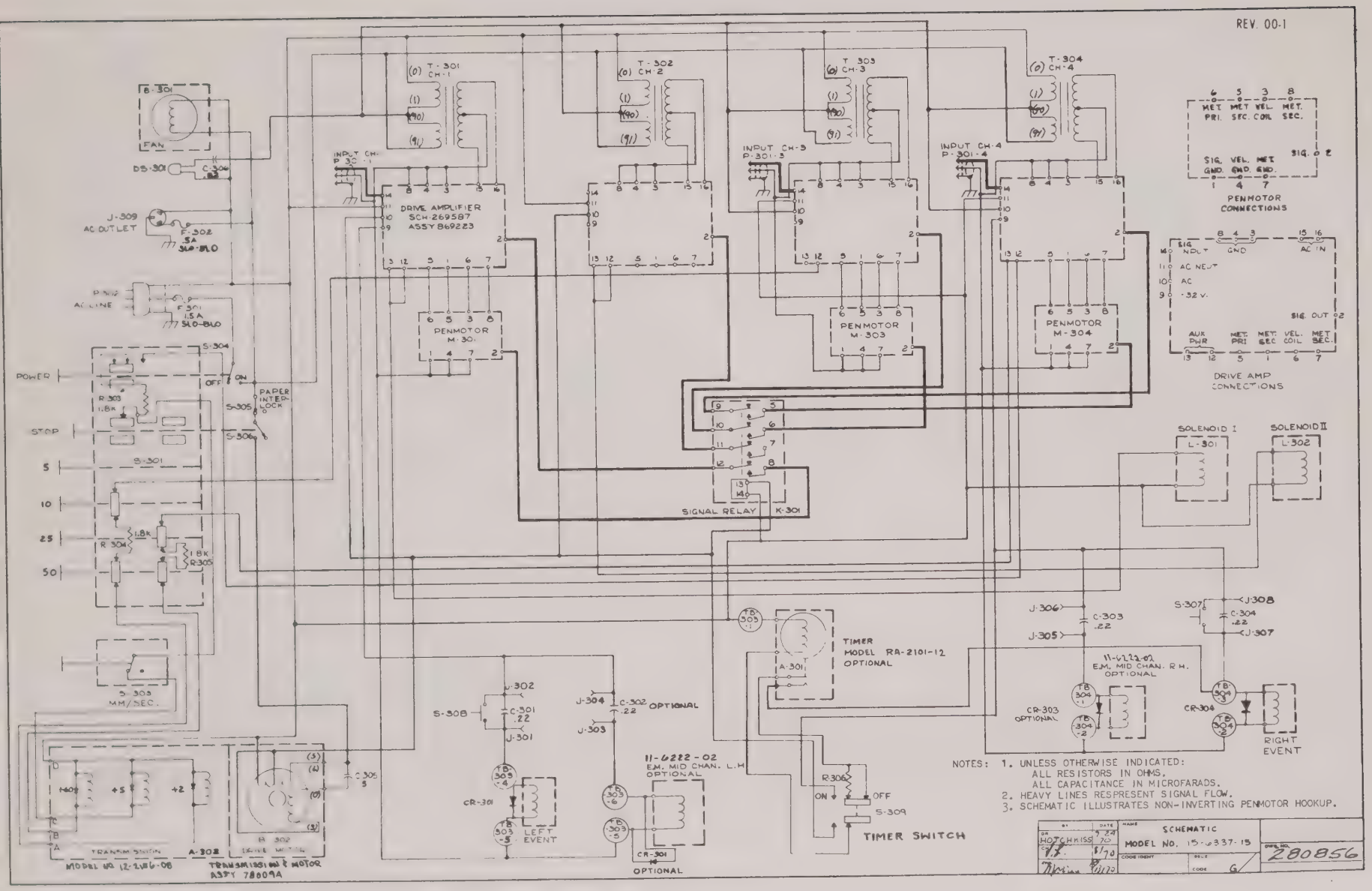

REV C-2
DRIVE AMPLIFIER SCH-269587 ASSY B69223
PENMOTOR ASSY B67060 NON INVERTING HOOKUP
PENMOTOR M-301
PENMOTOR M-302
PENMOTOR M-303
PENMOTOR M-304
SIGNAL RELAY K-301
DRIVE AMP CONNECTIONS
SOLENOID I L-301
SOLENOID II L-302
OPTIONAL TIMER MOD. NO. RA-2101-10
MODEL 11-6222-02 E.M. MID CHAN. L.H. OPTIONAL
MODEL 11-6222-02 E.M. MID CHAN. R.H. OPTIONAL
TIMER SWITCH
RECORDER, MARK 440
SCHEMATIC MODEL NO. 15-6347-10
269874


REV. A-2
DRIVE AMPLIFIER SCH-269587 ASSY 869223
PENMOTOR M-301
PENMOTOR M-302
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
DRIVE AMP CONNECTIONS
SIGNAL RELAY K-301
SOLENOID I L-301
SOLENOID II L-302
TIMER MODEL RA-2101-12 OPTIONAL
11-6222-02 E.M. MID CHAN. L.H. OPTIONAL
11-6222-02 E.M. MID CHAN. R.H. OPTIONAL
TIMER SWITCH
S-309
LEFT EVENT
RIGHT EVENT
CR-303 OPTIONAL
CR-304
CR-301
OPTIONAL
MODEL NO 12-2186-08
TRANSMISSION MOTOR ASSY 78809A
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS,
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES RESPRESENT SIGNAL FLOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6347-15
280090

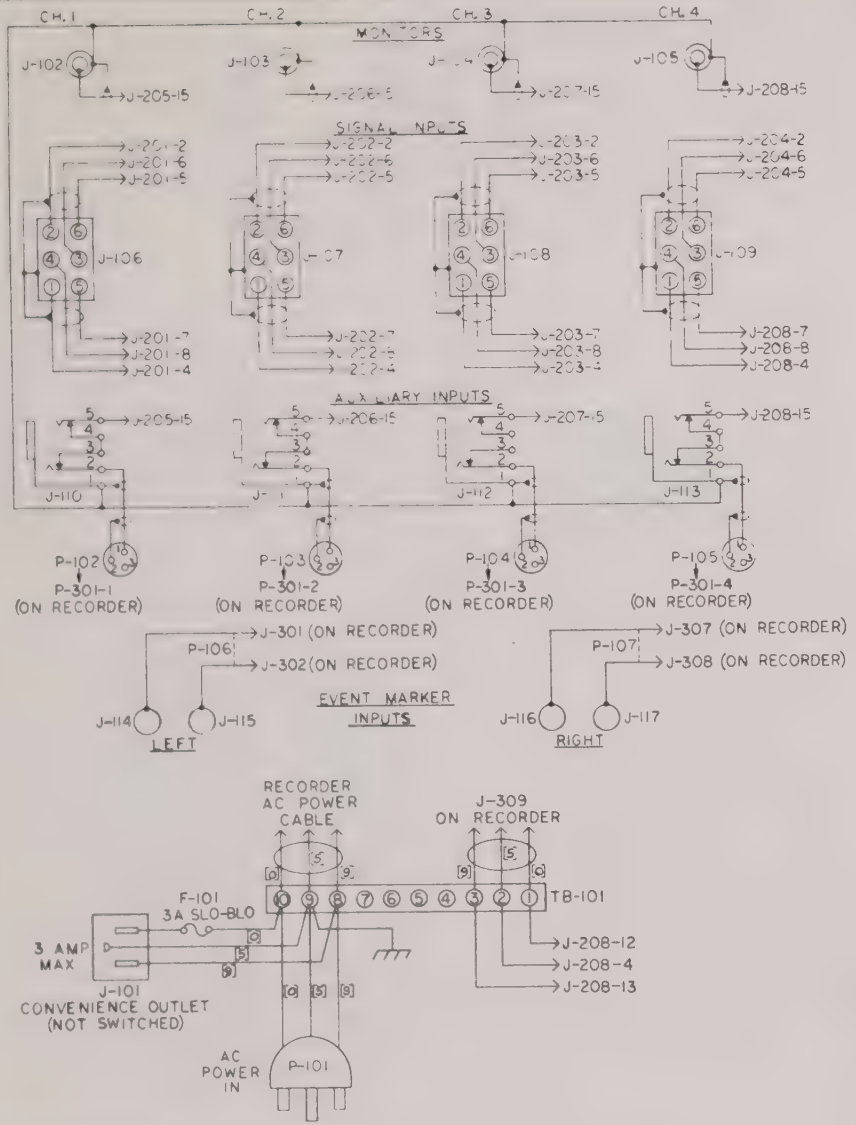

REV 00-1
B-301
FAN
DS-301
C-306
.22
J-309
AC OUTLET
F-302
1A
SLO BLO
P-302
AC LINE
F-301
3A
SLO-BLO
S-304
POWER
OFF
ON
STOP
R-303
1.8K
PAPER INTERLOCK
S-305
S-306
S-301
1
5
25
125
R-304
1.8K
1.8K
R-305
S-303
MM/SEC.
T-301 CH-1
T-302 CH-2
T-303 CH-3
T-304 CH-4
(0)
(1)
(90)
(91)
INP-T CH-1
P-301-1
INPUT CH-2
P-301-2
INPUT CH-3
P-301-3
INPUT CH 4
P-301-4
DRIVE AMPLIFIER
SCH-269587
ASSY 869223
PENMOTOR
M-301
PENMOTOR
M-303
PENMOTOR
M-304
PENMOTOR ASSY 867060
NON INVERTING HOOK UP
MET PRI
MET SEC.
VEL COIL
MET SEC.
GND
SIGNAL IN 02
SIGNAL RELAY
K-301
GND
AC IN
AC NEUT.
AC
-32 V.
SIG OUT 02
AUX PWR
MET PRI
MET SEC.
VEL COIL
MET SEC.
DRIVE AMP CONNECTIONS
SOLENOID I
L-301
SOLENOID II
L-302
OPTIONAL TIMER
MOD. NO. RA-2101-10
A-301
TB 303-1
J-306
J-305
C-303
.22
OPTIONAL
S-307
J-308
C-304
.22
J-307
MODEL NO 11-6222-02
E.M. MID CHAN. R.H.
OPTIONAL
CR-303
OPTIONAL
CR-304
TB 304-1
TB 304-2
TB 304-3
TB 304-4
RIGHT EVENT
J-302
S-308
C-301
.22
J-301
J-304
C-302
.22
OPTIONAL
J-303
MODEL NO 11-6222-02
E.M. MID CHAN. L.H
OPTIONAL
TB 303-1
TB 303-4
TB 303-6
TB 303-5
CR-301
LEFT EVENT
CR-302
OPTIONAL
R-306
ON
OFF
S-309
TIMER SWITCH
TRANSMISSION
A-302
MODEL NO 12-2154-08
DRIVE MOTOR
TRANSMISSION & MOTOR
ASS'Y 769783
C-305
.4
+40V
+25V
+5V
RECORDER, MARK 440
SCHEMATIC
MODEL NO. 15-6337-00
DRWG NO 280854
7-24-70
G

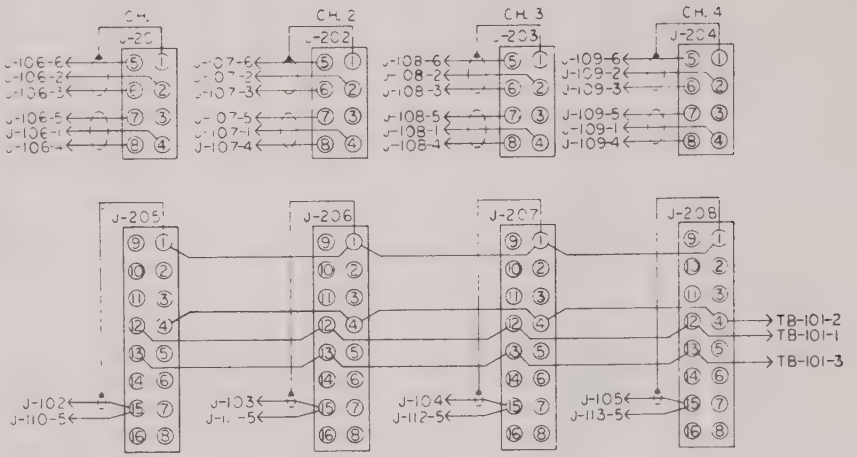

REV 00-1
B-301
FAN
DS-301
C-304
J-309
AC OUTLET
F-302
5A
SLO-BLO
P-302
AC LINE
F-301
1.8A
SLO-BLO
S-304
POWER
OFF
ON
PAPER INTERLOCK
S-305
S-306
STOP
R-303
1.8K
S-301
1
5
25
125
R-304
1.8K
R-305
1.8K
S-303
MM/SEC.
T-301 CH-1
T-302 CH-2
T-303 CH-3
T-304 CH-4
INPUT CH-1 P-301-1
INPUT CH-2 P-301-2
INPUT CH-3 P-301-3
INPUT CH-4 P-301-4
DRIVE AMPLIFIER SCH-269587 ASSY 869223
PENMOTOR M-301
PENMOTOR M-303
PENMOTOR M-304
SIGNAL RELAY K-301
SOLENOID I L-301
SOLENOID II L-302
MET PRI
MET SEC.
VEL COIL
MET SEC.
SIG. GND
VEL GND
MET GND
SIG.
PENMOTOR CONNECTIONS
SIG. INPUT
GND
AC IN
AC NEUT.
AC
-32 V.
SIG. OUT
AUX PWR
MET PRI
MET SEC
VEL COIL
MET SEC.
DRIVE AMP CONNECTIONS
TIMER MODEL RA-2101-12 OPTIONAL
A-301
J-306
C-303 .22 OPTIONAL
J-305
S-307
J-308
C-304 .22
J-307
11-6222-02 E.M. MID CHAN. R.H. OPTIONAL
CR-303 OPTIONAL
CR-304
RIGHT EVENT
S-308
J-302
C-301 .22
J-301
J-304
C-302 .22 OPTIONAL
J-303
11-6222-02 E.M. MID CHAN. L.H OPTIONAL
CR-301
LEFT EVENT
OPTIONAL
R-306
ON
OFF
S-309
TIMER SWITCH
+25
+5
-60
C-305
5
TRANSMISSION A-302
MODEL NO 12-2154-08
DRIVE MOTOR
TRANSMISSION NOT ASSY 780092
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS.
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL FLOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6337-05
280855


REV. 00-1
T-301 CH-1
T-302 CH-2
T-303 CH-3
T-304 CH-4
B-301 FAN
DS-301
J-309 AC OUTLET
F-302 1A SLO-BLO
P-302 AC LINE
F-301 3A SLO-BLO
S-304 POWER
R-303 1.8K
S-305 PAPER INTERLOCK
S-306 STOP
S-301
5
10
25
50
R-304 1.8K
R-305 1.8K
S-303 MM, SEC
DRIVE AMPLIFIER SCH-269587 ASSY B69223
PENMOTOR M-301
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR ASSY. NO'S 880221 & 867060 NON-INVERTING HOOK UP
MET PRI MET SEC VEL COIL MET SEC
GND SIG IN
SIGNAL RELAY K-301
SIG IN GND AC IN
AC NEUT.
AC
32 V.
SIG. OUT
AUX PWR MET PRI MET SEC VEL COIL MET SEC
DRIVE AMP. CONNECTIONS
SOLENOID I L-301
SOLENOID II L-302
J-306
J-305
C-303 .22 OPTIONAL
S-307
J-308
C-304 .22
J-307
MODEL 11-6222-02 E.M. MID CHAN. R.H. OPTIONAL
TB 304-1
CR-303 OPTIONAL
TB 304-2
TB 304-3
CR-304
RIGHT EVENT
TB 303-1
TIMER MOD. NO. RA-2101-10 OPTIONAL
A-301
S-308
J-301
C-301 .22
J-302
J-303
C-302 .22 OPTIONAL
J-304
MODEL 11-6222-02 E.M. MID CHAN. L.H. OPTIONAL
TB 303-4
CR-301
TB 303-5
LEFT EVENT
CR-302 OPTIONAL
TB 303-6
R-306
ON
OFF
S-309
TIMER SWITCH
TB A
+60
+5
+2
TRANSMISSION A-302
MODEL NO 12-2156-08
C-305
4
M-302 DRIVE MOTOR
TRANSMISSION & MOTOR ASSY 769795
NOTES:
1. UNLESS OTHERWISE INDICATED ALL RESISTOR VALUES IN OHMS. ALL CAPACITOR VALES IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL FLOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOK UP.
4. ( ) INDICATES EIA COLOR CODE.
RECORDER MK-440
SCHEMATIC MODEL NO. 15-6337-10
DUBAL
96795
280272


REV. 00-1
T-301 CH-1
T-302 CH-2
T-303 CH-3
T-304 CH-4
FAN
DS-301
C-304
J-309 AC OUTLET
F-302 .5A SLO-BLO
P-302 AC LINE
F-301 1.5A SLO-BLO
INPUT CH-1 P-301-1
INPUT CH-2 P-301-2
INPUT CH-3 P-301-3
INPUT CH-4 P-301-4
DRIVE AMPLIFIER SCH 269587 ASSY B69223
PENMOTOR M-301
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
DRIVE AMP CONNECTIONS
SIG. INPUT
GND
AC IN
AC NEUT
AC
32 V.
SIG. OUT
AUX PWR
MET PRI
MET SEC
VEL COIL
MET SEC.
S-304
POWER
OFF
ON
STOP
PAPER INTERLOCK
S-305
S-306
S-301
5
10
25
50
R-303 1.8K
R-304 1.8K
R-305 1.8K
S-303 MM/SEC.
SIGNAL RELAY K-301
SOLENOID I L-301
SOLENOID II L-302
TIMER MODEL RA-2101-12 OPTIONAL
A-301
TB 305
J-306
J-305
C-303 .22
S-307
J-308
C-304 .22
J-307
11-6222-02 E.M. MID CHAN. R.H. OPTIONAL
CR-303 OPTIONAL
CR-304
RIGHT EVENT
J-302
S-308
C-301 .22
J-301
J-304
C-302 OPTIONAL
J-303
11-6222-02 E.M. MID CHAN. L.H OPTIONAL
CR-301
LEFT EVENT
OPTIONAL
R-306
ON
OFF
S-309
TIMER SWITCH
C-305 .5
TRANSMISSION A-302
DRIVE MOTOR
MODEL NO 12-286-08
TRANSMISSION & MOTOR ASSY 780094
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS,
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES RESPRESENT SIGNAL FLOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6337-15
HOTCHKISS
280856
SIZE
CODE
G

REV. 00-1





DR HOTCHKISS	DATE 5-19-70	NAME DIAGRAM, WIRING	
	CODE IDENT 96795	ISSUE CODE G	DWG NO 280385

APPENDIX A

A.1 GENERAL

Gould 440 Recorder, Model 15-63X7-XX1636, is identical to the unit described in this manual except it includes a one-millivolt/division preamplifier for each analog channel. This appendix describes specifications, operation, calibration, and illustrated parts. Physical dimensions are 13.97" W x 17.50" H x 8.87" D.

A.2 SIGNAL INPUT SPECIFICATIONS

Measurement Range . . . . . 1 millivolt per chart division to 50 volts d-c full scale (50 chart divisions).

Input Circuit . . . . . Diferential, balanced-to-ground

Input Impedance . . . . . 10 megohms balanced, 5 megohms each termin to ground

In-Phase Rejection . . . . . 60dB at 60 Hz with maximum source unbalance of one kilohm at one MV/Div sensitivity setting (decreasing on higher sensitivity settings).

Maximum Input Signal . . . . . 500 Volts d-c or peak-to-peak (either input to ground).

Maximum Common Mode Voltage . . . . . 10,000 times the sensitivity setting up to a maximum of 500 volts.

SENSITIVITY SETTING	MAX. COMMON-MODE VOLTAGE
1 mv/div	10V d-c
2 mv/div	20V d-c
5 mv/div	50V d-c
10 mv/div	100V d-c
20 mv/div	200V d-c
All Others	500V d-c

A.3 OPERATION

The following front panel controls for each analog channel:

SENSITIVITY control . . . . . Provides 13-step attenuation of the input signal. Attenuation steps are 1, 2, 5, 10, 20, 50, 100, 200, 500 millivolts per division, and 1, 2, 5, and 10 volts per division.

SENSITIVITY X1 control . . . . . Provides intermediate sensitivities between the fixed settings of the stepped SENSITIVITY control. When in the full clockwise (detent) position, the sensitivity is fixed as indicated on the stepped SENSITIVITY control.

When rotated counterclockwise, the sensitivity is less than indicated on the stepped SENSITIVITY control to a maximum ratio of 2.5 to 1. This control is fitted with a locking nut to prevent inadvertent turning.

POSITION control . . . . . Permits pen positioning anywhere within the channel and allows either edge of channel, or any point between to be used as zero signal position. This control is fitted with a locking knob to prevent inadvertent turning.

Follow paragraph 3.4, steps 1 through 5. Then proceed with the steps outlined below.

a. Set preamplifier SENSITIVITY control to OFF.

b. Turn preamplifier SENSITIVITY X1 control full CCW (detent position) and secure with locking knob.

c. Position pen at exact chart center or any other desired signal-zero position with POSITION control. Secure with locking knob.

d. Switch SENSITIVITY control to a range that will permit maximum deflection without going beyond chart edge. Chart deflection will be proportional to SENSITIVITY control setting for voltage being recorded.

e. Select a chart speed that will best display signal with respect to recording frequency.

A.4 CALIBRATION

Calibration is identical to those procedures described in that manual except as follows:

a. Apply all test voltages direct to signal input pin (connection No. 14 shown on test point location drawing at the rear of the manual).

b. After standard calibration has been completed, connect drive amplifier input to operating configuration.

c. Turn SENSITIVITY control to OFF, and use POSITION control to set pen at exact chart center.

d. Vary SENSITIVITY X1 control throughout its range. Adjust preamplifier balance resistor for no change in pen deflection as SENSITIVITY X1 control is varied.

Schematics for the various 440 models affected by this appendix are as follows:

MODEL	SCHEMATIC
15-6347-001636	282177
15-6347-051636	282201
15-6347-101636	282207
15-6347-151636	282309
15-6337-001636	282312
15-6337-051636	282206
15-6337-101636	282311
15-6337-151636	282310

A.4 PARTS IDENTIFICATION

Parts identified on the following figures affect figures in the manual as follows:

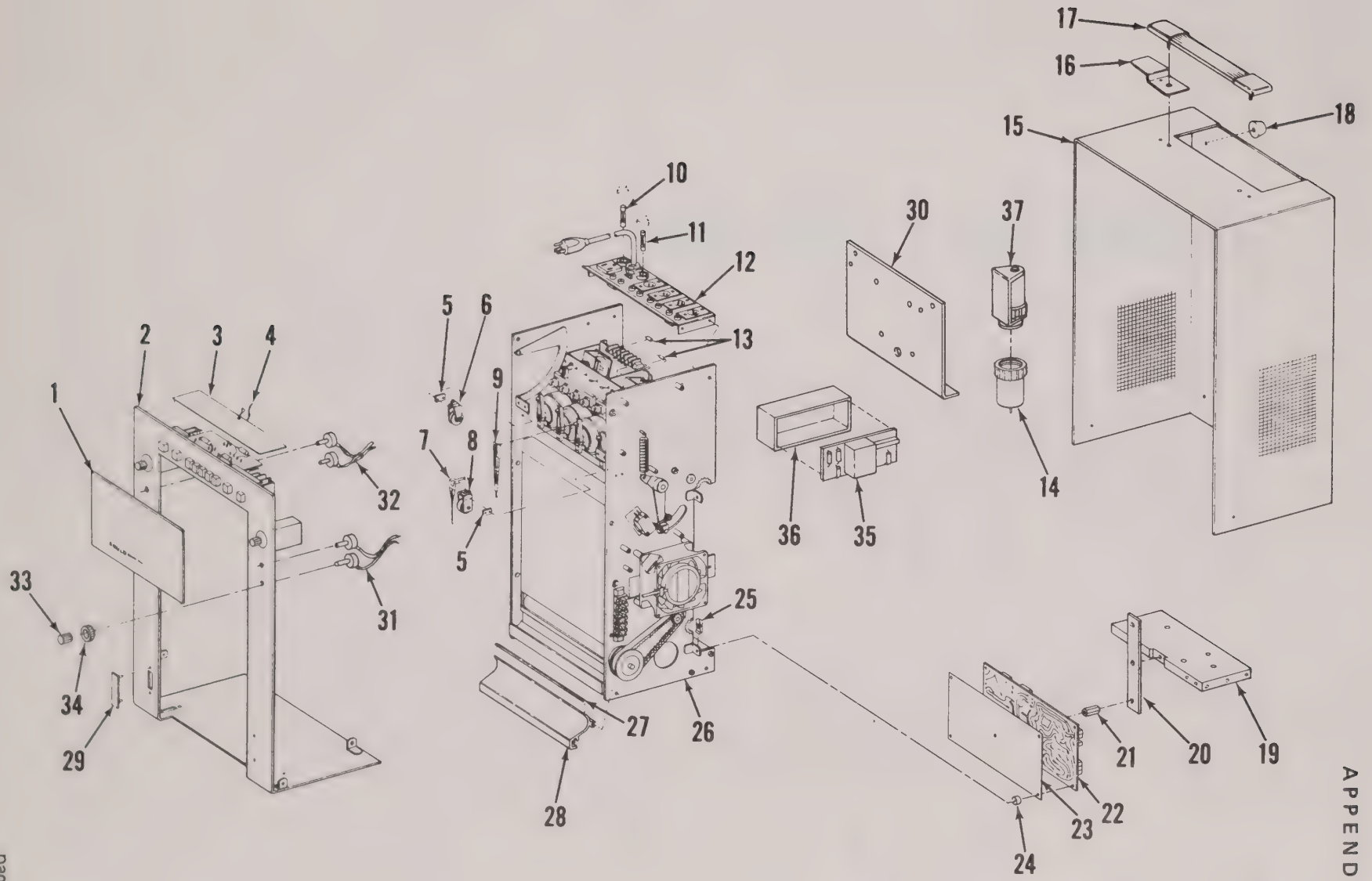
OLD FIGURE	NEW FIGURE
7-1	A-1
7-2	A-2
7-3	A-3
7-4	A-4

In addition to the above, Item 2 of Figure 7-8 is 881978, and Item 2 of Figure 7-9 is 881979.

EXPLODED VIEW PARTS LIST
GOULD 15-63X7-XX1636 RECORDER ASSY
FIGURE A-1

ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
1	769553	Panel Subassy, Door-Pen	
2	No P/N	Panel Assy, Front (-00, -05) Fig A-2	
2	No P/N	Panel Assy, Front (-10, -15) Fig A-2	
3	280280	Insulation	
4	232997-3	Strap, Retaining	
5	269791	Spacer, Event Marker	
6	11-2123-31	Event Marker Assy, LH	
7	11-2873-20	Pen Assy, Event	
8	11-2123-32	Event Marker Assy, RH	
9	11-2823-33	Pen Assy, Analog	
10	116198-10	Fuse, Slo-Blo (-00, -10)	F-302
10	266924-7	Fuse, Slo-Blo (-05, -15)	F-302
11	116198-13	Fuse, Slo-Blo (-00, -10)	F-301
11	266924-1	Fuse, Slo-Blo (-05, -15)	F-301
12	No P/N	Bracket Assy, Connector (6347 series) Fig. A-4	
12	No P/N	Bracket Assy, Connector (6337 series) Fig. A-4	
13	231887	Semiconductor, Diode	CR-301, 304
14	11-2730-01	Ink Cartridge Assy	
15	682361	Case Subassy	
16	269753	Bracket, Power Cord	
17	280285-2	Handle	
18	120903-221	Bumper	
19	382014	Spacer, Cabinet	
20	282013	Strap, Support	
21	244501-14	Spacer	

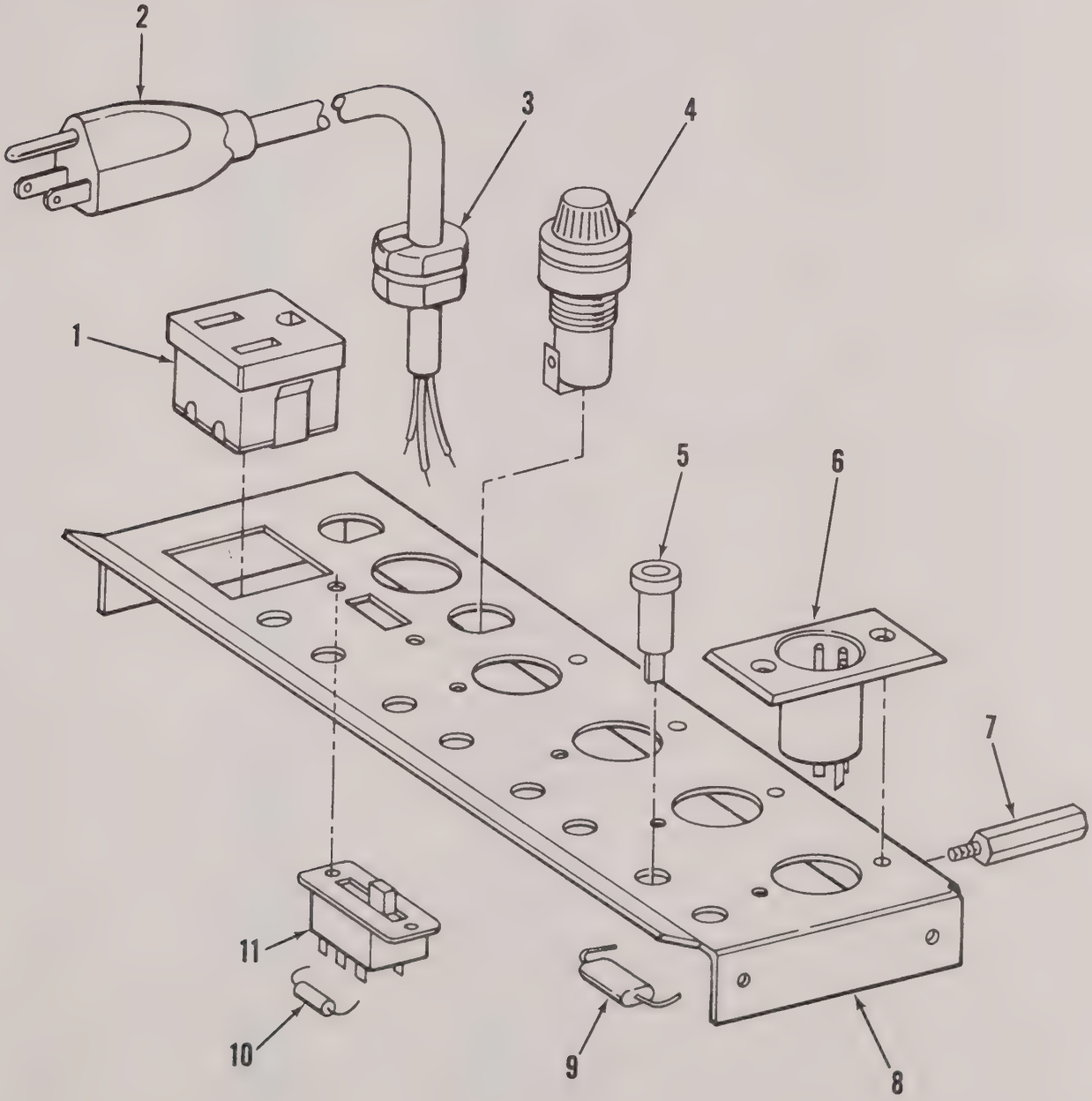
ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
22	869223	Network Assy, Drive Amp—Fig. A-11	
23	369896	Insulator	
24	1-269573-3	Spacer	
25	4-103838-11	Nut Sheet, Spring	
26	No P/N	Chassis Assy (-00, -05) Fig. A-3	
26	No P/N	Chassis Assy (-10, -15) Fig. A-3	
27	249668	Deflector, Paper	
28	769583	Chute, Paper	
29	246388	Cover, Panel	
30	382032	Bracket, Ink Supply	
31	883201	Harness Assy, RH	
32	883202	Harness Assy, LH	
33	231183	Knob	
34	231182	Nut	
35	766409	Preamplifier Assy	
36	666614	Shield Assy	
37	766243	Ink Plunger Assy	



GOULD 15-63X7-XX1636 RECORDER ASSY - FIGURE A-1

EXPLODED VIEW PARTS LIST
FRONT PANEL ASSY
FIGURE A-2

ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
1	882319	Panel Subassy, Front (3-Channel)	
1	882022	Panel Subassy, Front (4-Channel)	
2	128327	Lamp	DS-301
3	266063	Lampholder	
4	369636	Bracket, Switch	
5	269783	Bracket	
6	280278	Insulation	
7	269567	Switch, Sensitive	S-305, 306
8	5-115558-182	Resistor	R-303, 304, 305
9	264930	Switch, Pushbutton	S-301
10	269259	Switch, Pushbutton	S-303
11	269257	Switch, Pushbutton	S-307, 308
12	246552-1	Button, Push	
13	1-265849-4	Bracket	
14	886447	Switch Assy	S-101
15	267454	Cover	
16	667453	Insulator	
17	2-128693-1	Grommet	
18	665563	Knob Assy	

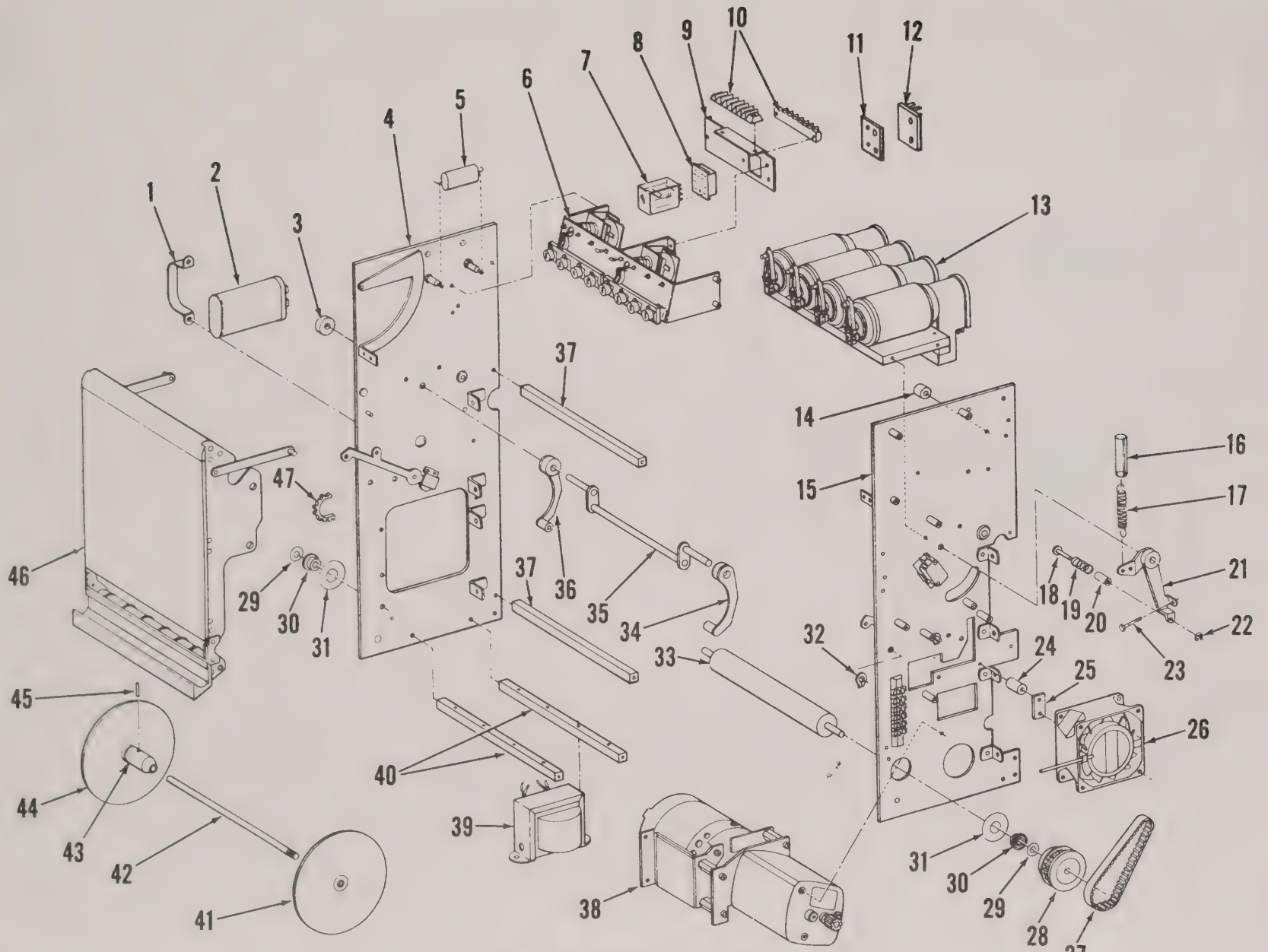


FRONT PANEL ASSEMBLY - FIGURE A-2

EXPLODED VIEW PARTS LIST (Sheet 1 of 2)
CHASSIS ASSEMBLY
FIGURE A-3

ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
1	263394-1	Clamp, Capacitor	
2	1-263395-405	Capacitor (-00, -10)	C-305
2	1-263395-505	Capacitor (-05, -15)	C-305
3	243443	Collar, Shaft	
4	No P/N	Plate Assy, LH Fig. 7-8	
5	10-261998-824	Capacitor	C-306
6	869786	Manifold Assy – Fig. 7-10	
7	269564	Relay, 4PDT	K-301
8	269574	Socket, Relay	
9	269691	Bracket	
10	265814-6	Terminal Board	TB-303, 304
11	282034	Plate, Mounting	
12	782497	Board, Terminal	
13	869751	Penmotor Shield Assy (6347 series) Fig. 7-7	
13	880237	Penmotor Shield Assy (6337 series) Fig. 7-7	
14	1-269579-3	Spacer, Threaded	
15	No P/N	Plate Assy, RH - Fig. 7-9	
16	0-108400-25	Insulation	
17	1-240031-3	Spring, Helical	
18	643919-10	Disc Assy, Friction	
19	269291	Spring, Compression	
20	0-108400-15	Insulation, Sleeve	
21	743913-10	Arm Subassy, Brake	
22	0-240731-2	Washer, Retainer	
23	31-119924-6220	Screw, Mach. Hex Head	
24	1-269575-1	Spacer	
25	269721	Bracket, Fan	
26	286404-1	Fan (-00, -10)	
26	286404-2	Fan (-05, -15)	
27	262381-6	Belt, Timing	
28	61-234144-11	Pulley, Timing Belt	
29	127271	Washer	
30	265741-1	Bearing, Ball	
31	265745-1	Washer, Plain Mylar	
32	1-227070-9	Ring, Retaining	
33	669634	Roll, Drive	
34	769867	Arm Sensor	
35	769865	Shaft, Sensor	
36	743915-10	Arm Sensor	
37	269546	Spacer	
38	769785	Motor/Transmission Assy (-00) Fig. 7-6	

ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
37	780092	Motor/Transmission Assy (-05) Fig. 7-6	
37	769795	Motor/Transmission Assy (-10) Fig. 7-6	
37	780094	Motor/Transmission Assy (-15) Fig. 7-6	
39	265542	Transformer	T-304 thru 304
40	269547	Spacer	
41	769551	Hub Assy, Supply Roll, Right	
42	683281	Shaft Subassy, Supply	
43	243444	Hub, Supply Roll, Left	
44	369542	Flange, Roll Supply	
45	3-119820-709	Pin, Grooved	
	769550	Shaft Assy (Includes 41, 42, 43, 44)	
46	869745	Table Assy, Writing – Fig. 7-5	
47	1-128693-3	Grommet, Caterpillar	

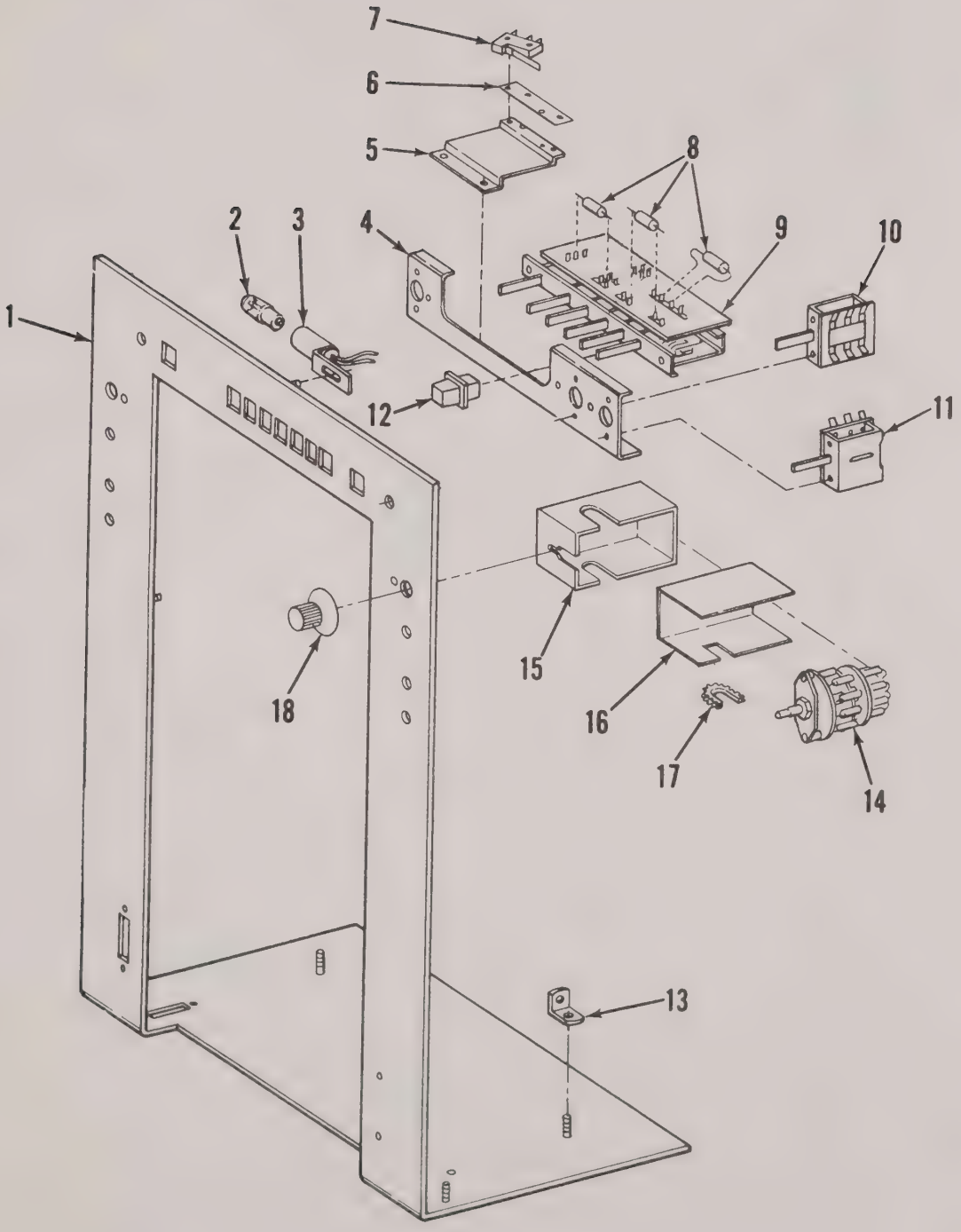


CHASSIS ASSEMBLY - FIGURE A-3

EXPLODED VIEW PARTS LIST
CONNECTOR BRACKET ASSY
FIGURE A-4

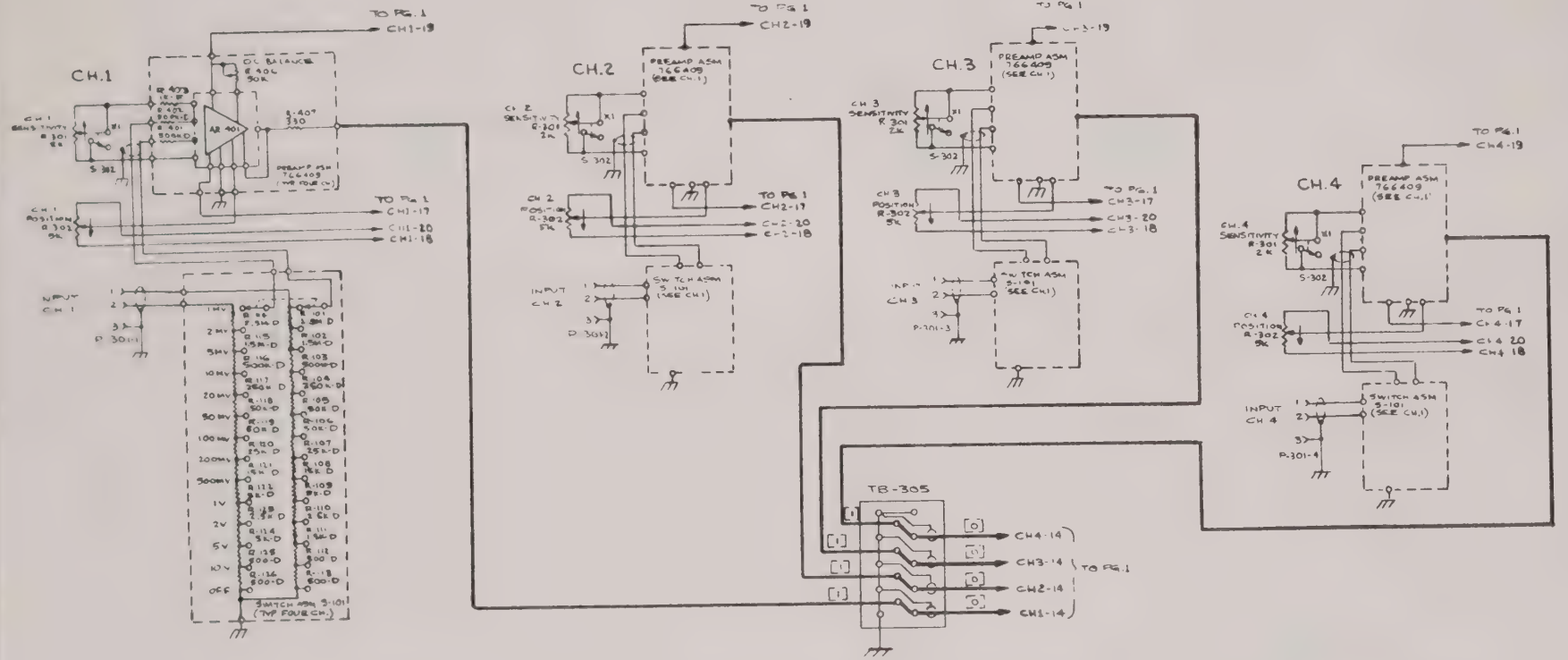
ITEM NO	PART NUMBER	DESCRIPTION	SYMBOL NO
1	244165	Connector, A-C	J-309
2	126295-7	Cable, 3-Conductor	P-302
3	108572-11	Bushing, Strain Relief	
4	129758	Fuse Holder	
5	265873-2	Jack, Banana	J-301 thru 308
6	234323	Connector, Receptacle	P-301-1 thru 301-4
7	1-280875-2	Spacer, Threaded	
*	2-113294-66	Button, Plug (6337 series)	
8	382040	Bracket, Connector (00, 10)	
8	382495	Bracket, Connector (05, 15)	
9	10-241145-224	Capacitor, Fixed	C-301 thru C-304
10	5-115557-100	Resistor	R-306
11	240224	Switch, Slide	S-309

* Button used in place of one Item 6.



CONNECTOR BRACKET ASSEMBLY - FIGURE A-4

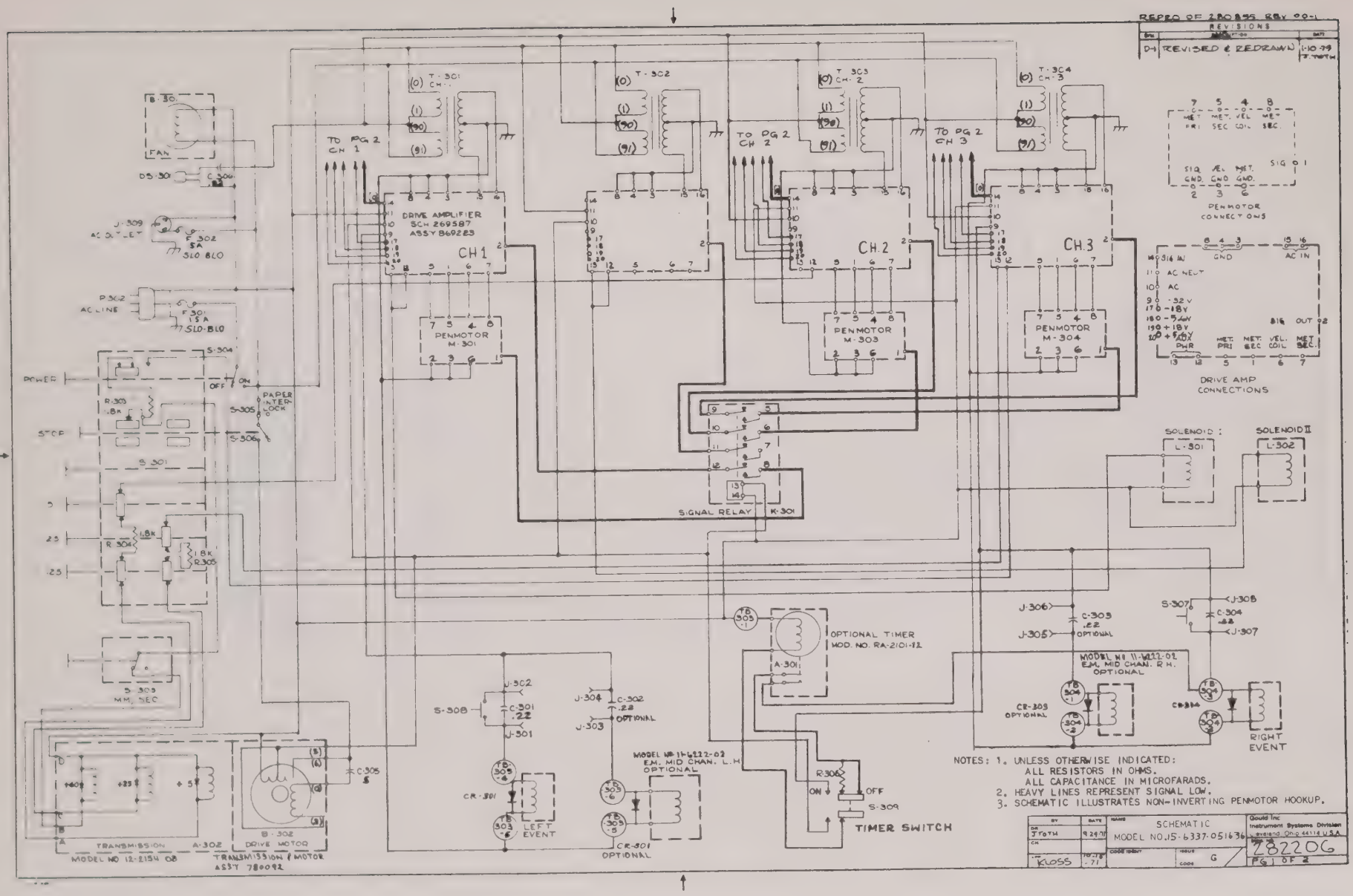
REPRO OF 280088 REV AE
REVISIONS
REVISED & REDRAWN
DRIVE AMPLIFIER SCH-269587 ASSY B69223
CH.1
CH.2
CH.3
CH.4
PENMOTOR M-301
PENMOTOR M-302
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
DRIVE AMP. CONNECTIONS
SOLENOID I L-301
SOLENOID II L-302
SIGNAL RELAY K-301
OPTIONAL TIMER MOD. NO. RA-2101-12
A-301
MODEL NO 11-6222-02 EM. MID CHAN. L.H. OPTIONAL
MODEL NO 11-6222-02 EM. MID CHAN. R.H. OPTIONAL
TIMER SWITCH
S-309
R-306
ON
OFF
POWER
STOP
PAPER OUT INTERLOCK
S-303 MM. REC
TRANSMISSION A-302
TRANSMISSION MOTOR ASSY 780092
LEFT EVENT
RIGHT EVENT
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS,
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL LOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6347-051636
Gould Inc. Instrument Systems Division Cleveland, Ohio 44114 U.S.A.
282201
PG 1 OF 2

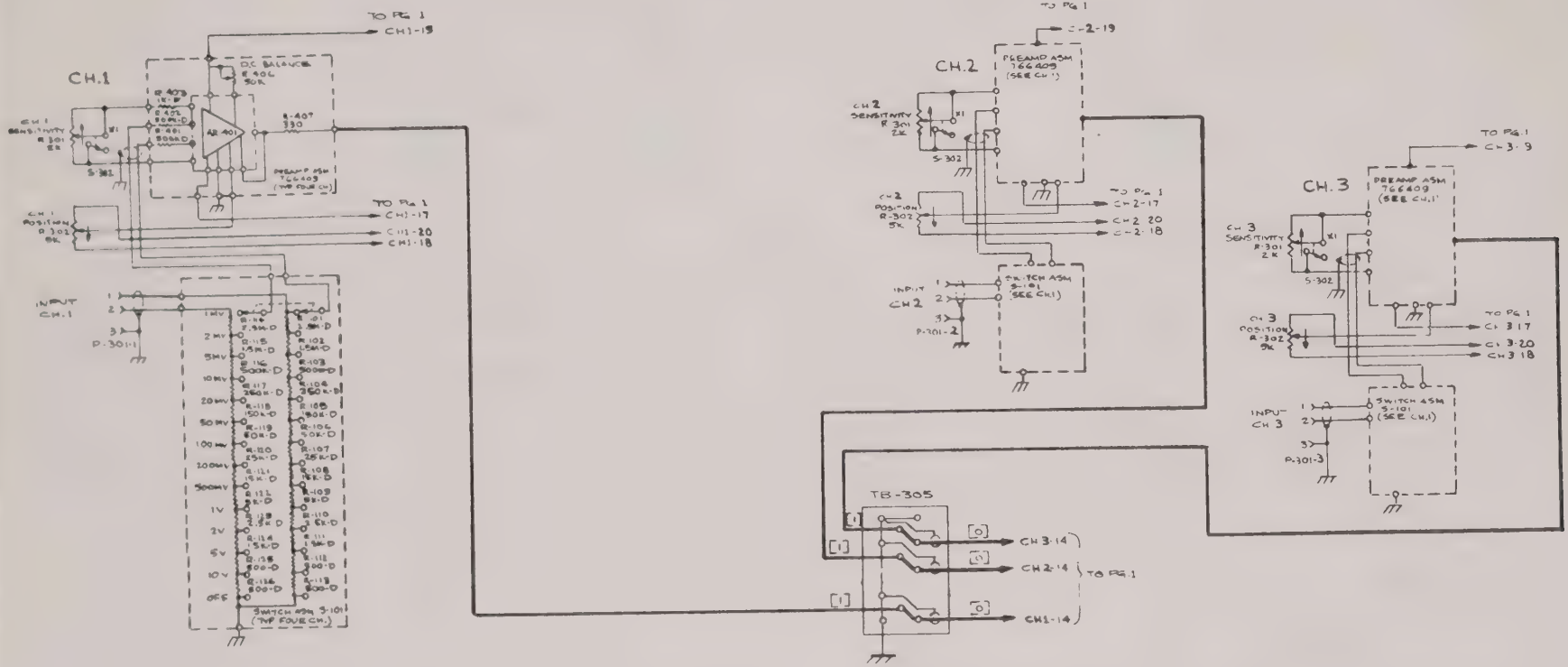


: WIRE COLORS IN EIA COLOR CODE SHOWN IN BRACKETS [ ]
NOTES:

BY	DATE	NAME	SCHEMATIC
DR J.TOTH	9-29-70		MOD.15-6347-051636
CH		CODE IDENT 96795	SIZE G
APP KLOSS	10-12-70		

Gould Inc
Instrument Systems Division
Cleveland, Ohio 44114 U.S.A.
282201
PG 2012


REPRO OF 280855 REV 00-1
REVISIONS
D-1 REVISED & REDRAWN 1-10-79 J. TOTH
T-301 CH. 1
T-302
T-303 CH. 2
T-304 CH. 3
TO PG 2 CH 1
TO PG 2 CH 2
TO PG 2 CH 3
B-301 FAN
DS-301
C-306
J-309 AC OUTLET
F-302 5A SLO BLO
P-302 AC LINE
F-301 1.5A SLO-BLO
DRIVE AMPLIFIER SCH 269587 ASSY 860283
CH 1
CH 2
CH 3
PENMOTOR M-301
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
DRIVE AMP CONNECTIONS
S-304 POWER
OFF ON
PAPER INTERLOCK
S-305
S-306
STOP
R-303 1.8K
S-301
R-304 1.8K
R-305 1.8K
.25
S-303 MM, SEC
SIGNAL RELAY K-301
SOLENOID I L-301
SOLENOID II L-302
OPTIONAL TIMER MOD. NO. RA-2101-12
A-301
J-306
J-305
C-303 .22 OPTIONAL
S-307
J-308
C-304 .22
J-307
MODEL NO 11-4222-02 E.M. MID CHAN. R.H. OPTIONAL
CR-303 OPTIONAL
C-304
RIGHT EVENT
J-302
S-308
C-301 .22
J-301
J-304
C-302 .22 OPTIONAL
J-303
MODEL NO 11-4222-02 E.M. MID CHAN. L.H. OPTIONAL
CR-301
LEFT EVENT
CR-301 OPTIONAL
R-306
ON
OFF
S-309
TIMER SWITCH
C-305 .5
+40V
+25V
+5V
TRANSMISSION A-302
MODEL NO 12-2154 08
B-302 DRIVE MOTOR
TRANSMISSION & MOTOR ASS'Y 780092
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS.
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL LOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. JS-6337-051636
Gould Inc Instrument Systems Division Cleveland, Ohio 44114 U.S.A.
782206
PG 1 OF 2
J TOTH 9-29-77
KLOSS 10-7-77
ISSUE CODE G



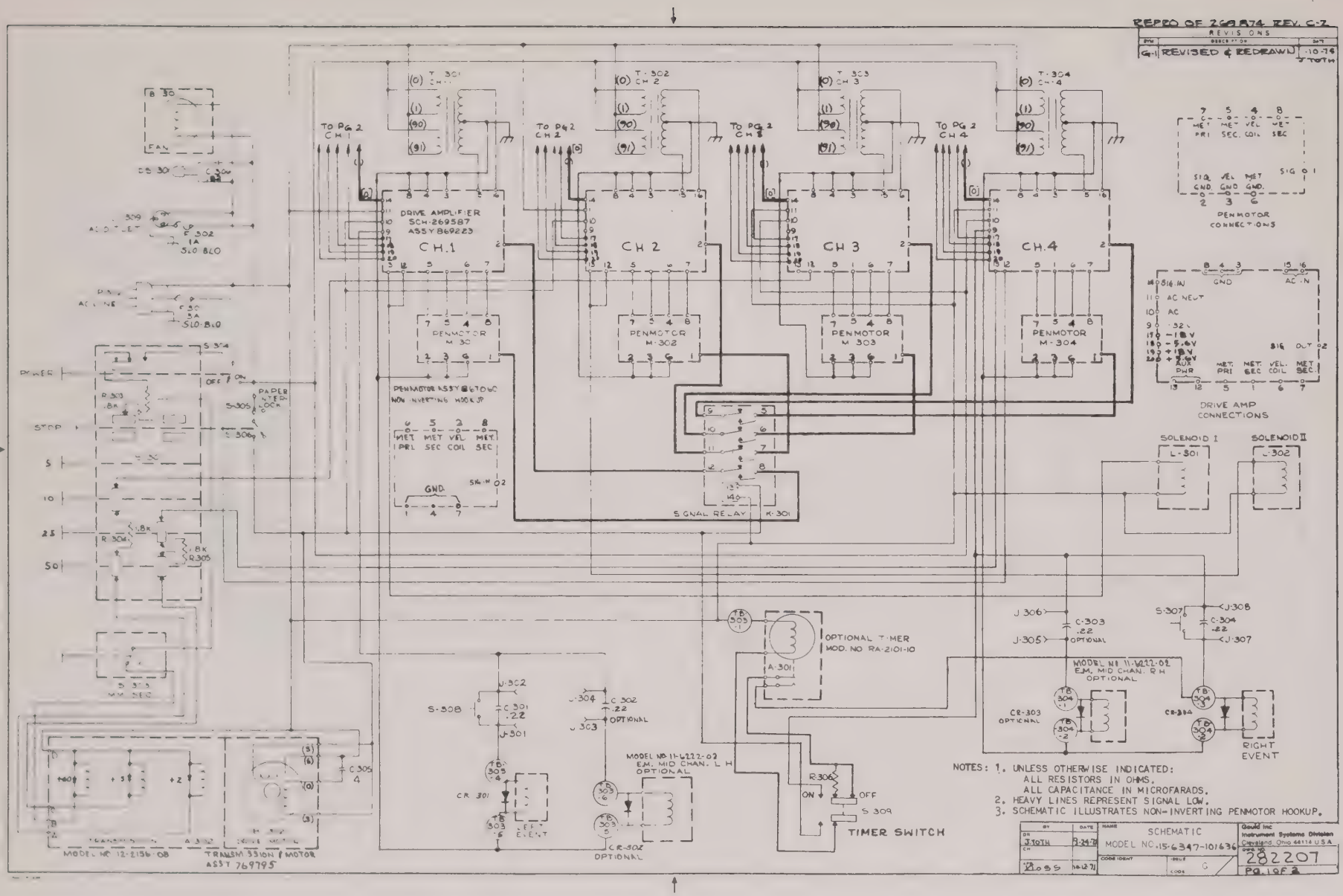
REVISIONS

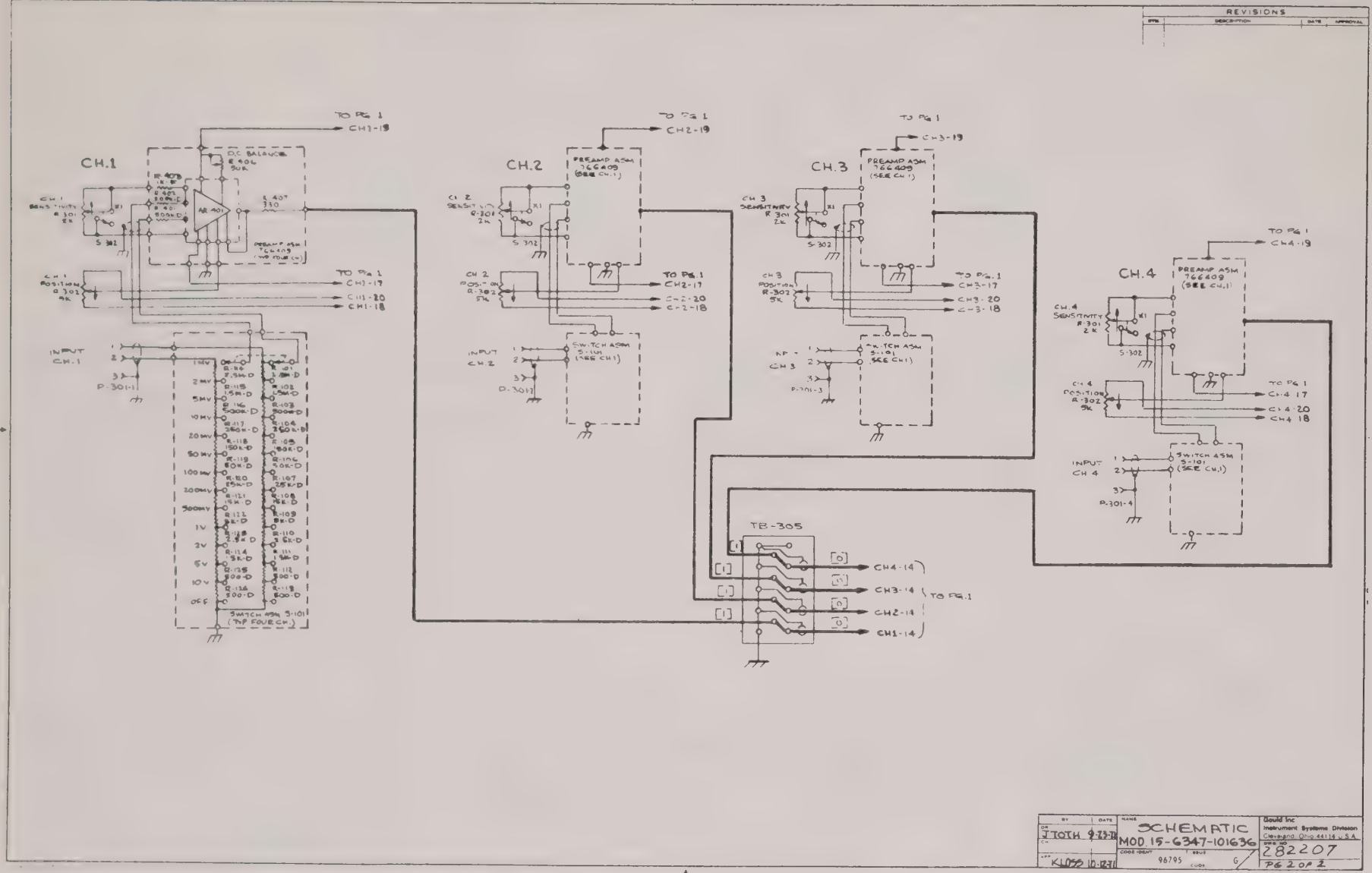
SYM	DESCRIPTION	DATE	APPROVAL

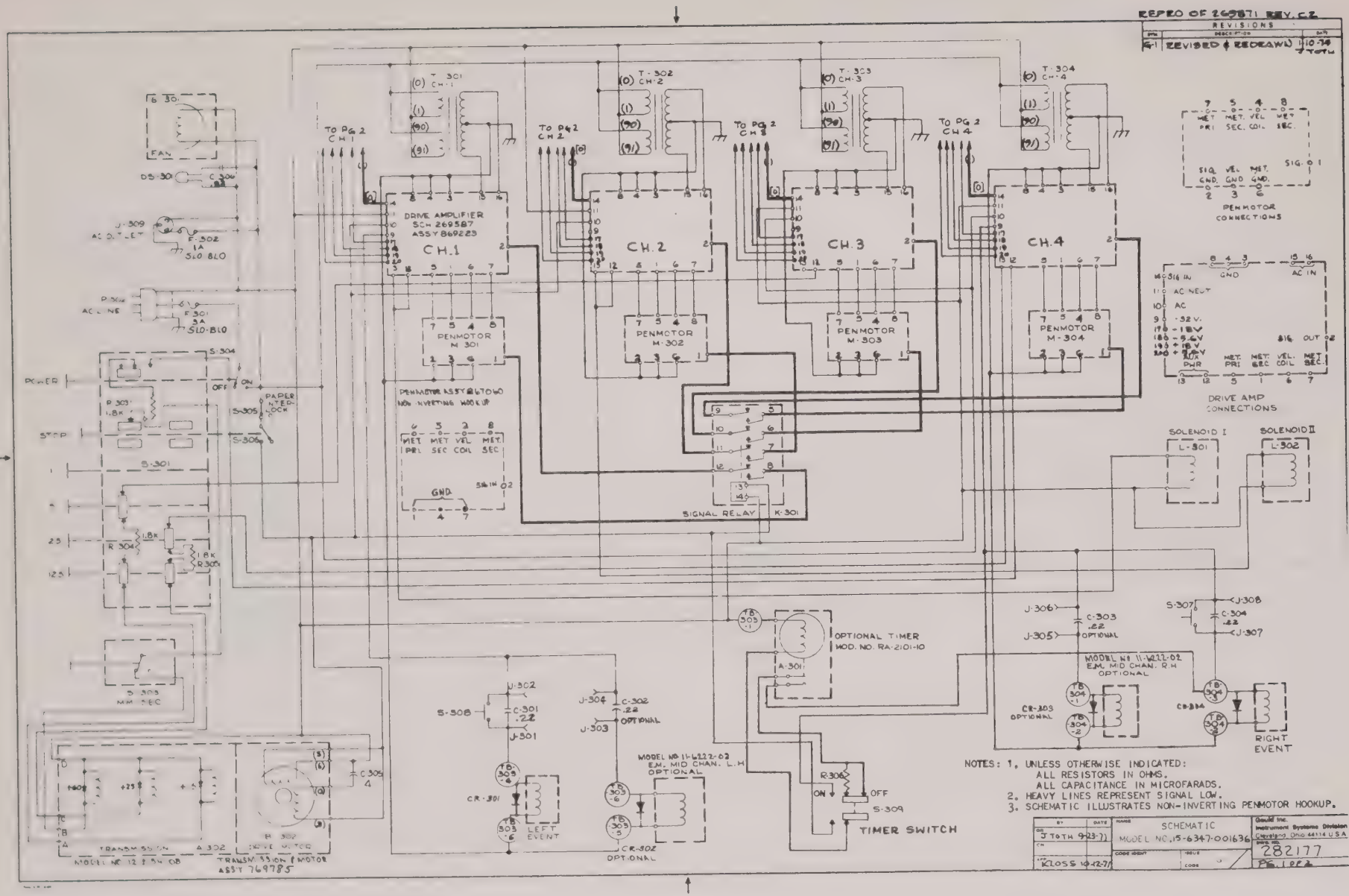
: WIRE COLORS IN EIA COLOR CODE SHOWN IN BRACKETS []

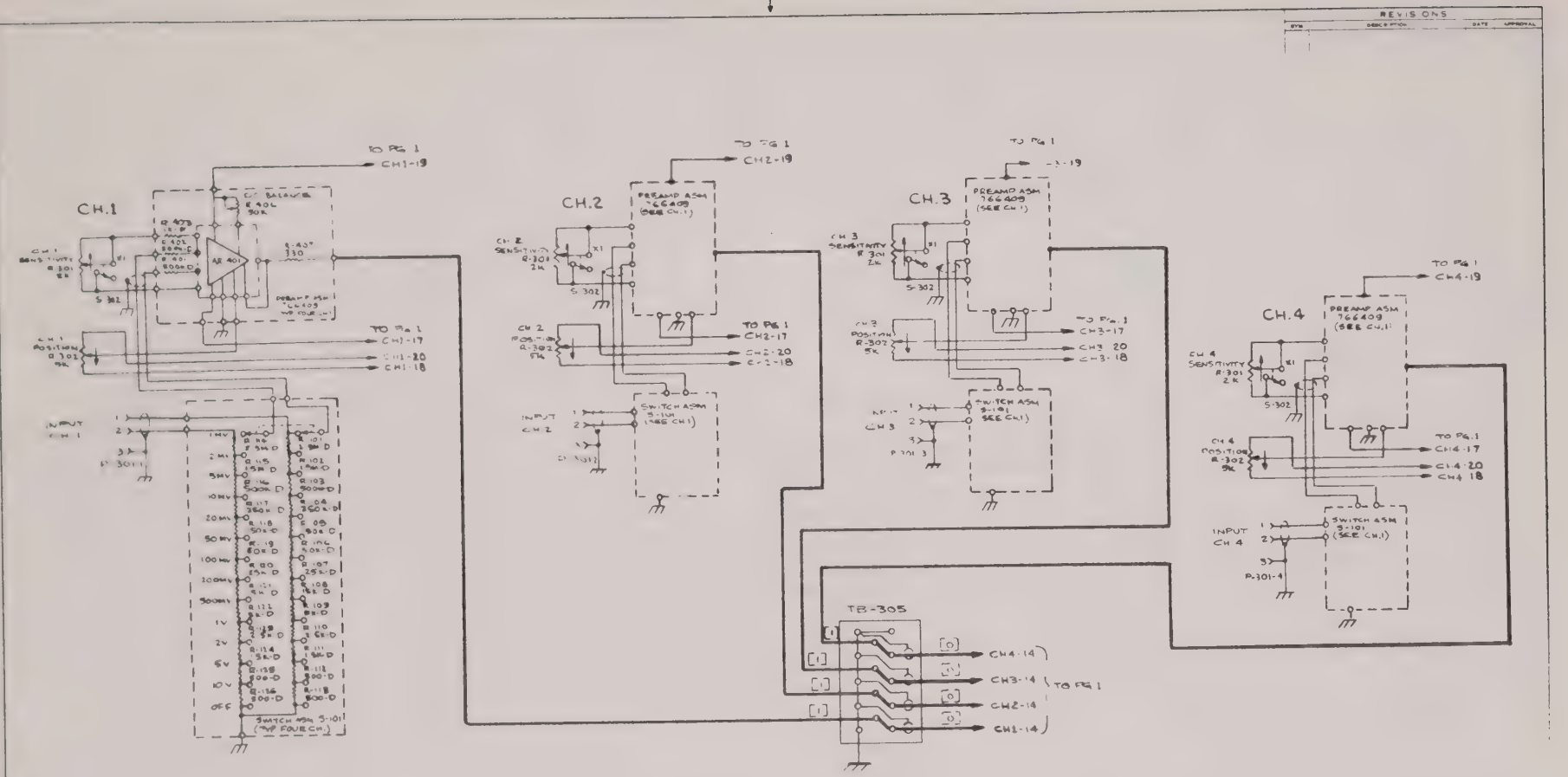
NOTES:

BY	DATE	SCHEMATIC	Gould Inc Instrument Systems Division Cleveland, Ohio 44114 U.S.A.
J TOTH	1-10-75	MOD. 15-6337-05163G	DWG NO 282206
CODE IDENT 96795	SIZE G		PG 2 OF 2


REPRO OF 269874 REV. C-2
REVISIONS
G-1 REVISED & REDRAWN 10-76 J TOTH
T-301 CH-1
T-302 CH-2
T-303 CH-3
T-304 CH-4
TO PG 2 CH 1
TO PG 2 CH 2
TO PG 2 CH 3
TO PG 2 CH 4
DRIVE AMPLIFIER SCH-269587 ASSY B69223
CH.1
CH 2
CH 3
CH.4
PENMOTOR M-301
PENMOTOR M-302
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR ASSY B67060 NON INVERTING HOOK UP
PENMOTOR CONNECTIONS
DRIVE AMP CONNECTIONS
SOLENOID I L-301
SOLENOID II L-302
SIGNAL RELAY K-301
FAN
F-302 1A SLO BLO
AC LINE
C-301 5A SLO BLO
S-304 POWER
STOP
S
10
25
50
R-303 1.8K
R-304 1.8K
R-305 1.8K
S-305 PAPER TYPE LOCK
S-306
S-307A MM SEC
S-308 J-302 C-301 .22 J-301
J-304 C-302 .22 OPTIONAL J-303
OPTIONAL TIMER MOD. NO RA-2101-10
A-301
J-306 C-303 .22 OPTIONAL J-305
S-307 J-308 C-304 .22 J-307
MODEL NO 11-6222-02 EM. MID CHAN. L H OPTIONAL
MODEL NO 11-6222-02 EM. MID CHAN. R H OPTIONAL
CR-301
CR-302 OPTIONAL
CR-303 OPTIONAL
CR-304
LEFT EVENT
RIGHT EVENT
R-306 ON OFF S-309 TIMER SWITCH
MODEL NO 12-2156-08
TRANSMISSION & MOTOR ASST 769795
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS,
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL LOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6347-101636
Gould Inc Instrument Systems Division Cleveland, Ohio 44114 U.S.A.
DRG NO 282207
Pg. 1 OF 2

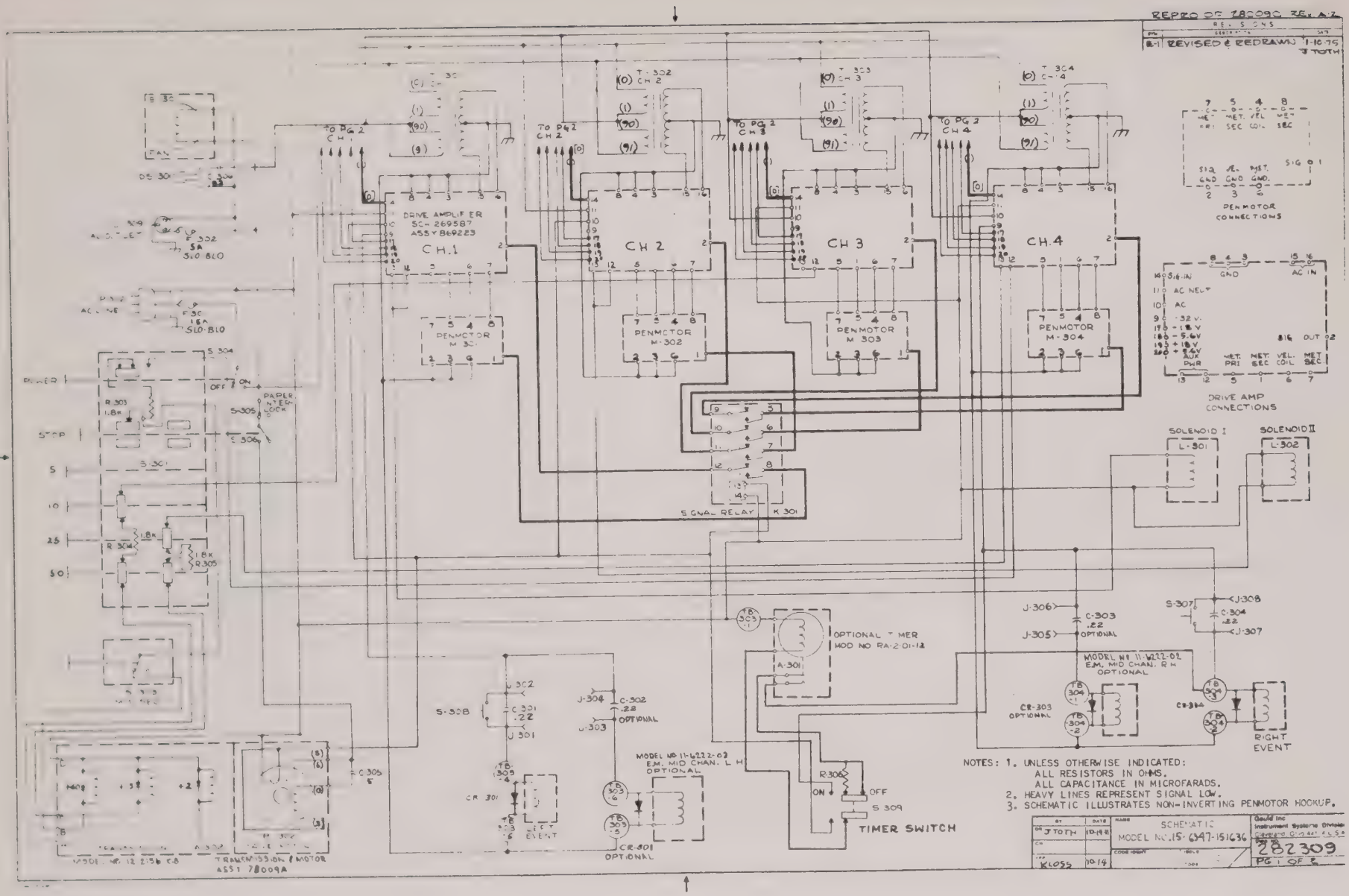

REVISIONS
CH.1
CH.2
CH.3
CH.4
TO PG 1
CH1-19
CH2-19
CH3-19
CH4-19
DC BALANCE
PREAMP ASM 766409 (SEE CH.1)
INPUT CH.1
INPUT CH.2
INPUT CH.3
INPUT CH.4
P-301-1
P-301-2
P-301-3
P-301-4
SWITCH ASM S-101 (TYP FOUR CH.)
SWITCH ASM S-101 (SEE CH.1)
1MV
2 MV
5MV
10 MV
20 MV
50 MV
100 MV
200MV
500MV
1V
2V
5V
10 V
OFF
TB-305
CH4-14
CH3-14
CH2-14
CH1-14
TO PG.1
SCHEMATIC
MOD 15-6347-101636
96795
282207
PG 2 OF 2
Gould Inc
Instrument Systems Division
Cleveland, Ohio 44114 U.S.A.


REPRO OF 269871 REV. C2
REVISIONS
REVISED & REDRAWN
DRIVE AMPLIFIER SCH 269587 ASSY 869223
CH.1
CH.2
CH.3
CH.4
PENMOTOR M-301
PENMOTOR M-302
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
DRIVE AMP CONNECTIONS
SOLENOID I L-301
SOLENOID II L-302
SIGNAL RELAY K-301
OPTIONAL TIMER MOD. NO. RA-2101-10
TIMER SWITCH
TRANSMISSION MODEL NO. 12 & 24 OB
TRANSMISSION & MOTOR ASSY 769785
RIGHT EVENT
NOTES: 1, UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS.
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL LOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6347-001636
Gould Inc. Instrument Systems Division Cleveland, Ohio 44114 USA
282177
PG. 1 OF 2



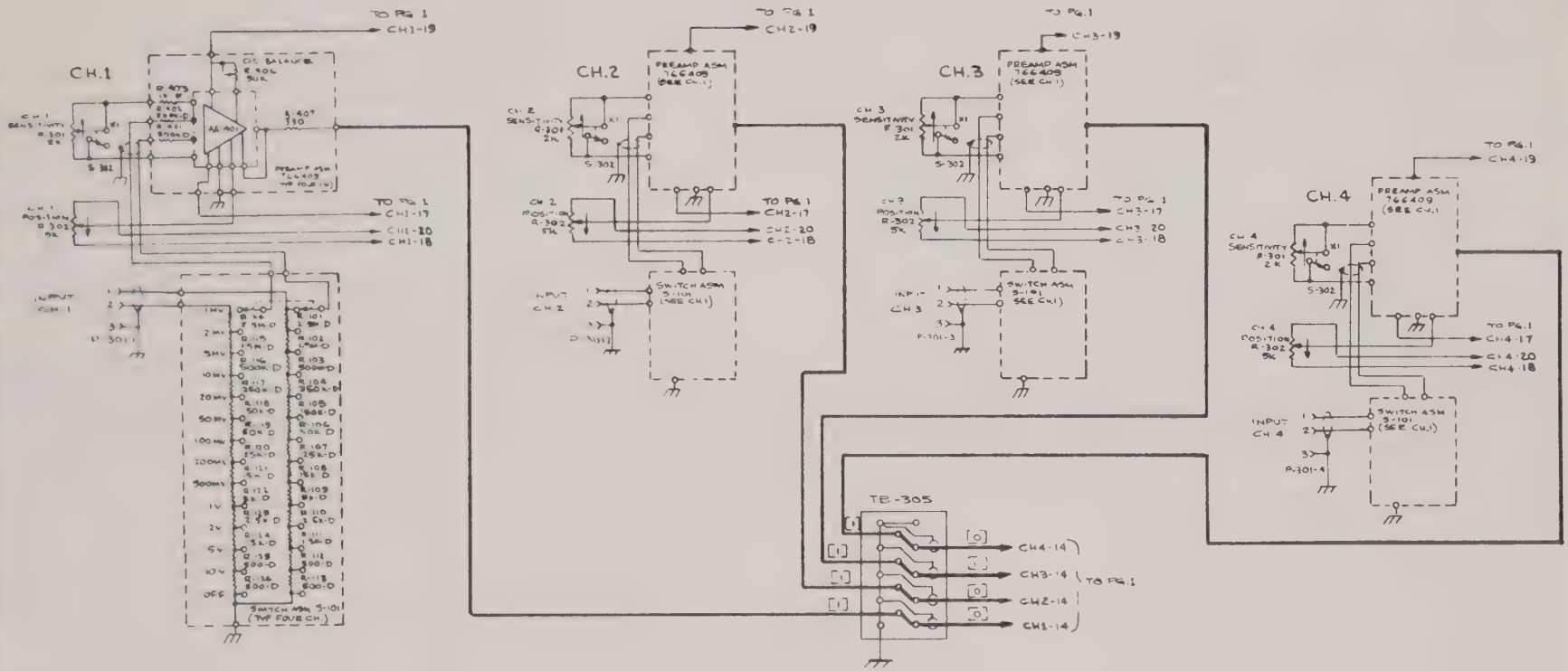
NOTES:
1. WIRE COLORS IN EIA COLOR CODE SHOWN IN BRACKETS [ ]

DR J. TOTH 9-13-71	NAME SCHEMATIC MOD 15-6347-001636	Gould Inc Instrument Systems Division Cleveland Ohio 44114 U.S.A.	
CH		DWG NO 282177	
APP K. LOSS 9-27-71	CODE IDENT 96795 / CODE	REV G	PG 2 OF 2


REPRO OF 782090 SH A-2
B-1 REVISED & REDRAWN 1-10-75 J TOTH
DRIVE AMPLIFIER SC-269587 ASSY 869223
CH.1
CH 2
CH 3
CH.4
PENMOTOR M-301
PENMOTOR M-302
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
DRIVE AMP CONNECTIONS
SIG 1 GND
SIG 2 GND
MET. SEC GND.
MET. PRI
VEL. COIL
MET. SEC
AC IN
AC NEUT
AUX PWR
SIG OUT 2
SOLENOID I L-301
SOLENOID II L-302
POWER
STOP
5
10
25
50
OFF ON
PAPER INTERLOCK
S-305
S-306
S-304
S-301
R-303 1.8K
R-304 1.8K
R-305 1.8K
SIGNAL RELAY K 301
OPTIONAL TIMER MOD NO RA-2-01-12
A-301
S-308
C-301 .22
C-302 .22 OPTIONAL
C-303 .22 OPTIONAL
C-304 .22
J-301
J-302
J-303
J-304
J-305
J-306
J-307
J-308
MODEL NO 11-6222-02 E.M. MID CHAN. L H OPTIONAL
MODEL NO 11-6222-02 E.M. MID CHAN. R H OPTIONAL
CR-301 OPTIONAL
CR-303 OPTIONAL
CR-304
LEFT EVENT
RIGHT EVENT
R-306
ON
OFF
S 309
TIMER SWITCH
TRANSMISSION MOTOR ASS'T 78009A
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS.
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL LOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6347-151636
Gould Inc Instrument Systems Division
282309
PG 1 OF 2
J TOTH 10-14
KLOSS 10-14

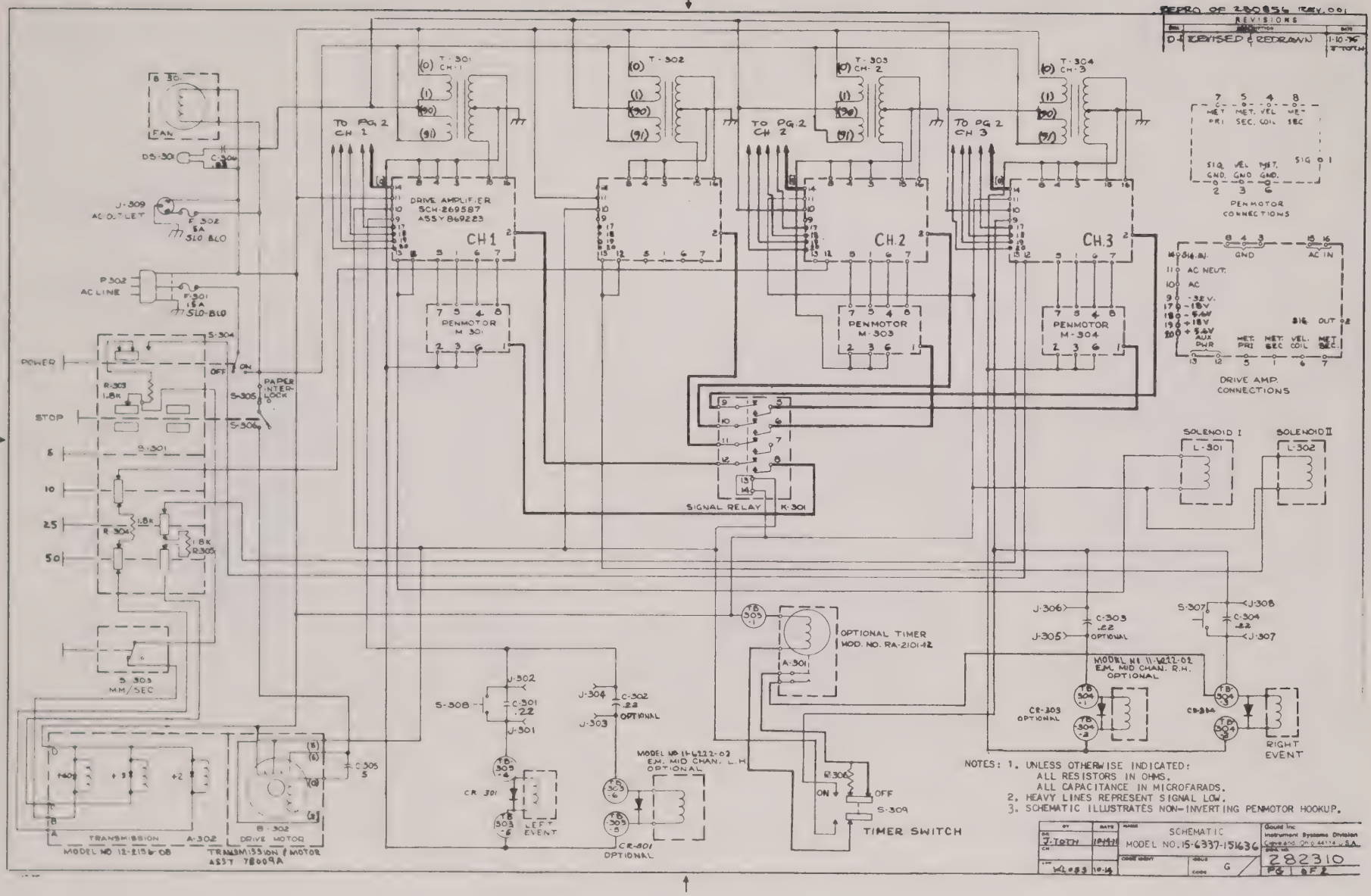
REPRO OF 282177 (NO REV.)

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
B-1	REDRAWN NO CHANGE	10-19-67	JTOTH



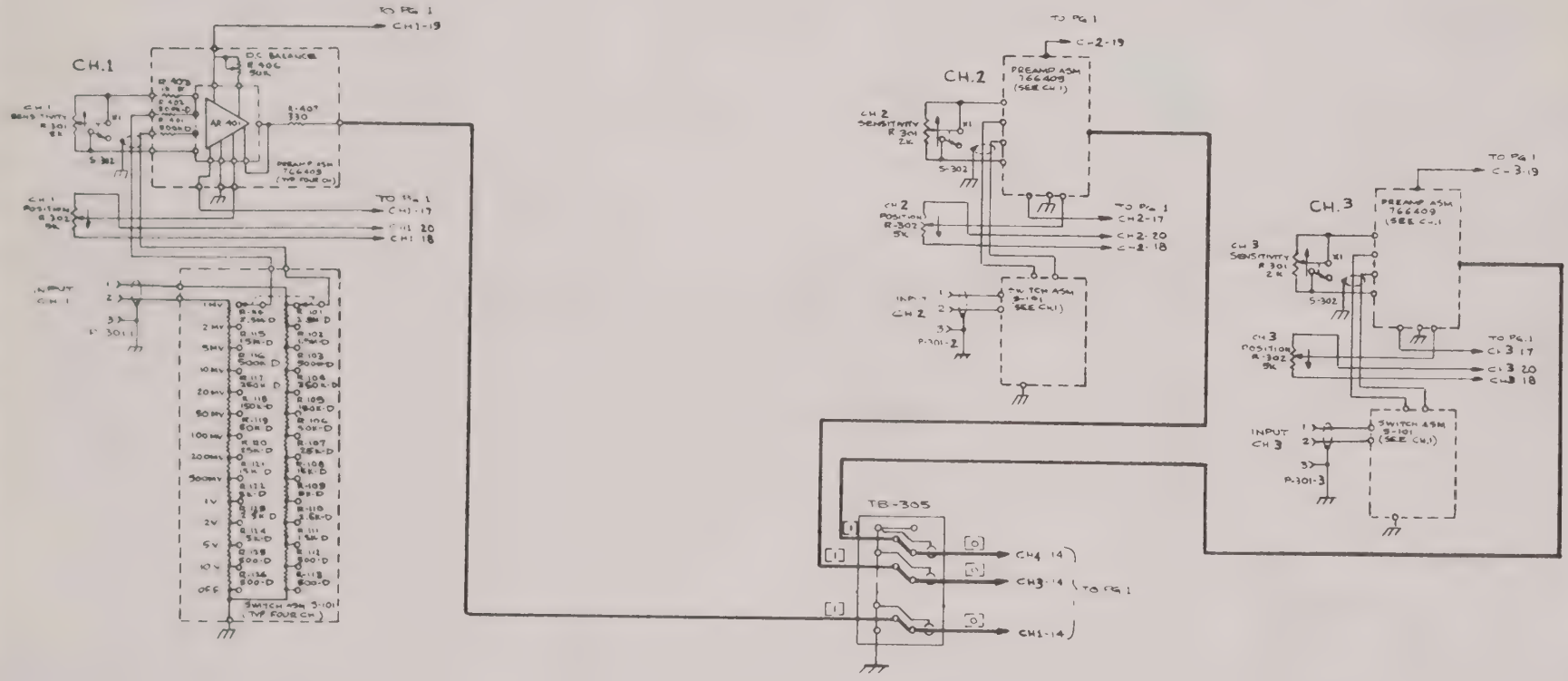
: WIRE COLORS IN EIA COLOR CODE SHOWN IN BRACKETS [ ]
NOTES:

BY J TOTH 10-19-67	NAME SCHEMATIC MOD. 15-6347-151636	Gould Inc Instrument Systems Division Cleveland, Ohio 44114 U.S.A.	
CK KLOSS 10-19-67	CODE IDENT 96795	SIZE G	DWG NO 282309
		CODE	PG 2 OF 2


REPRO OF 280936 REV. 001
REVISIONS
D-4 REVISED & REDRAWN 1-10-75
T-301 CH-1
T-302
T-303 CH-2
T-304 CH-3
TO PG. 2 CH 1
TO PG. 2 CH 2
TO PG. 2 CH 3
DRIVE AMPLIFIER SCH-269587 ASSY 869223
CH1
CH.2
CH.3
PENMOTOR M-301
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
SIG. GND. VEL. GND. MET. GND. SIG OUT
DRIVE AMP. CONNECTIONS
SIG. GND. AC IN
110 AC NEUT.
100 AC
90 -32 V.
170 -18 V
180 -5 AV
190 +18 V
200 +5 AV AUX PWR
MET. PRI. MET. SEC. VEL. COIL MET. SEC.
FAN
DS-301
C-304
J-309 AC OUTLET
F-302 8A SLO BLO
P-302 AC LINE
F-301 15A SLO-BLO
S-304
POWER
OFF ON
R-303 1.8K
STOP
PAPER INTERLOCK
S-305
S-306
S-301
5
10
25
50
R-304 1.8K
R-305 1.8K
S-303 MM/SEC
SIGNAL RELAY K-301
SOLENOID I L-301
SOLENOID II L-302
J-306
J-305
C-303 .22 OPTIONAL
S-307
J-308
C-304 .22
J-307
OPTIONAL TIMER MOD. NO. RA-2101-42
A-301
MODEL NO 11-6222-02 EM. MID CHAN. R.H. OPTIONAL
CR-303 OPTIONAL
CR-304
RIGHT EVENT
S-308
J-302
C-301 .22
J-301
J-304
C-302 .22 OPTIONAL
J-303
CR-301
LEFT EVENT
MODEL NO 11-6222-02 EM. MID CHAN. L.H. OPTIONAL
CR-601 OPTIONAL
R-306
ON
OFF
S-309
TIMER SWITCH
C-305 5
TRANSMISSION A-302
MODEL NO 12-2156-08
B-302 DRIVE MOTOR
TRANSMISSION / MOTOR ASS'Y 78009A
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS,
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL LOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6337-151636
Gould Inc Instrument Systems Division Cleveland, Ohio 44114 U.S.A.
282310
PG 1 OF 2

REPRO OF 282306 (NO REV)

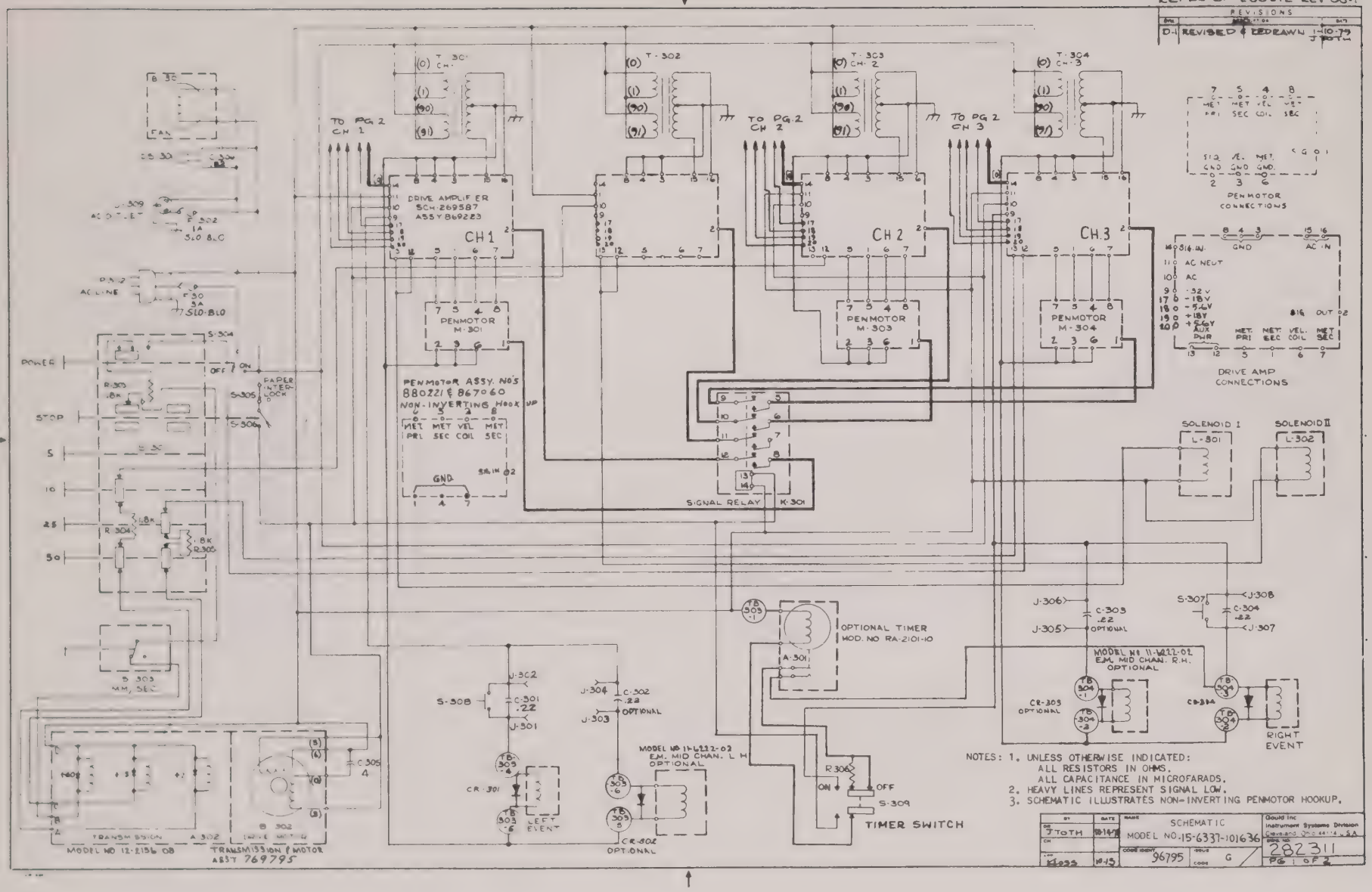
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A-1	REDRAWN NO CHANGE	1-10-74	J TOTH



: W.RE COLORS IN EIA COLOR CODE SHOWN IN BRACKETS [ ]

NOTES:

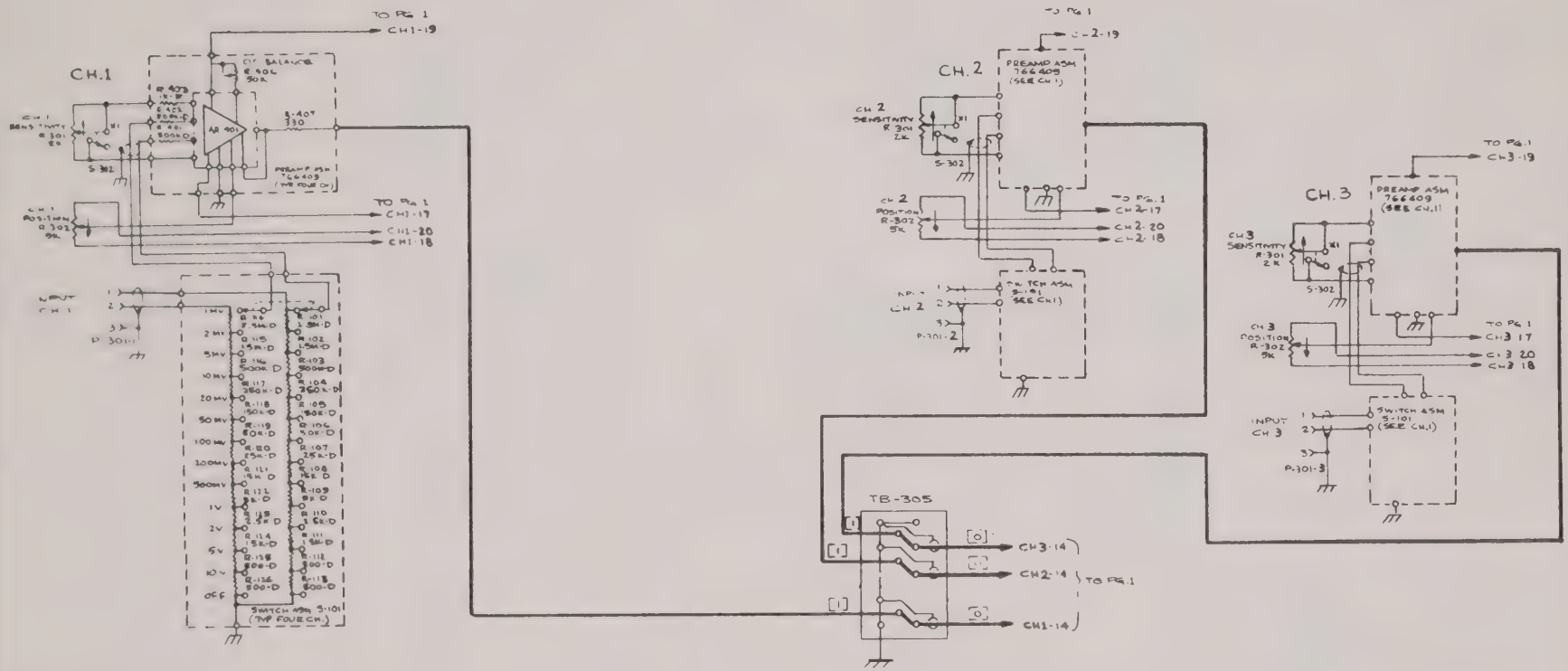
BY / DATE	NAME	Gould Inc	
DR J. TOTH 10-14-7	SCHEMATIC MODEL 19-6357-15 1636	Instrument Systems Division Cleveland, Ohio 44114 U.S.A.	
CH KLOSO 10-14-7	CODE IDENT 96795	SIZE CODE G	282310
			PG 2 OF 2


REPRO OF 280272 REV 00-1
REVISIONS
D-1 REVISED & REDRAWN 1-10-79 J POTTS
TO PG 2 CH 1
TO PG 2 CH 2
TO PG 2 CH 3
T-301 CH-1
T-302
T-303 CH-2
T-304 CH-3
DRIVE AMPLIFIER SCH-269587 ASSY B69283
CH1
CH2
CH3
PENMOTOR M-301
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
DRIVE AMP CONNECTIONS
PENMOTOR ASSY. NOS 880221 & 867060
NON-INVERTING HOOKUP
SIGNAL RELAY K-301
SOLENOID I L-301
SOLENOID II L-302
POWER
STOP
5
10
25
50
S-304
S-305
S-306
PAPER INTERLOCK
R-303 1.8K
R-304 1.8K
R-305 1.8K
B 303 MM, SEC
B 302 LINE MOTOR
TRANSMISSION A 302
MODEL NO 12-2136-08
TRANSMISSION & MOTOR ASSY 769795
C-305 .4
S-308
C-301 .22
J-301
J-302
J-303
J-304
C-302 .22 OPTIONAL
CR-301
CR-302 OPTIONAL
LEFT EVENT
MODEL NO 11-6232-02 E.M. MID CHAN. L.H. OPTIONAL
OPTIONAL TIMER MOD. NO RA-2101-10
A-301
R-306
S-309
ON
OFF
TIMER SWITCH
J-306
J-305
C-303 .22 OPTIONAL
S-307
J-308
C-304 .22
J-307
MODEL NO 11-6232-02 E.M. MID CHAN. R.H. OPTIONAL
CR-303 OPTIONAL
CR-304
RIGHT EVENT
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS.
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL LOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
SCHEMATIC
MODEL NO. 15-6337-101636
Gould Inc Instrument Systems Division
96795
282311
PG 1 OF 2

REPRO OF 282206 (NO REV)

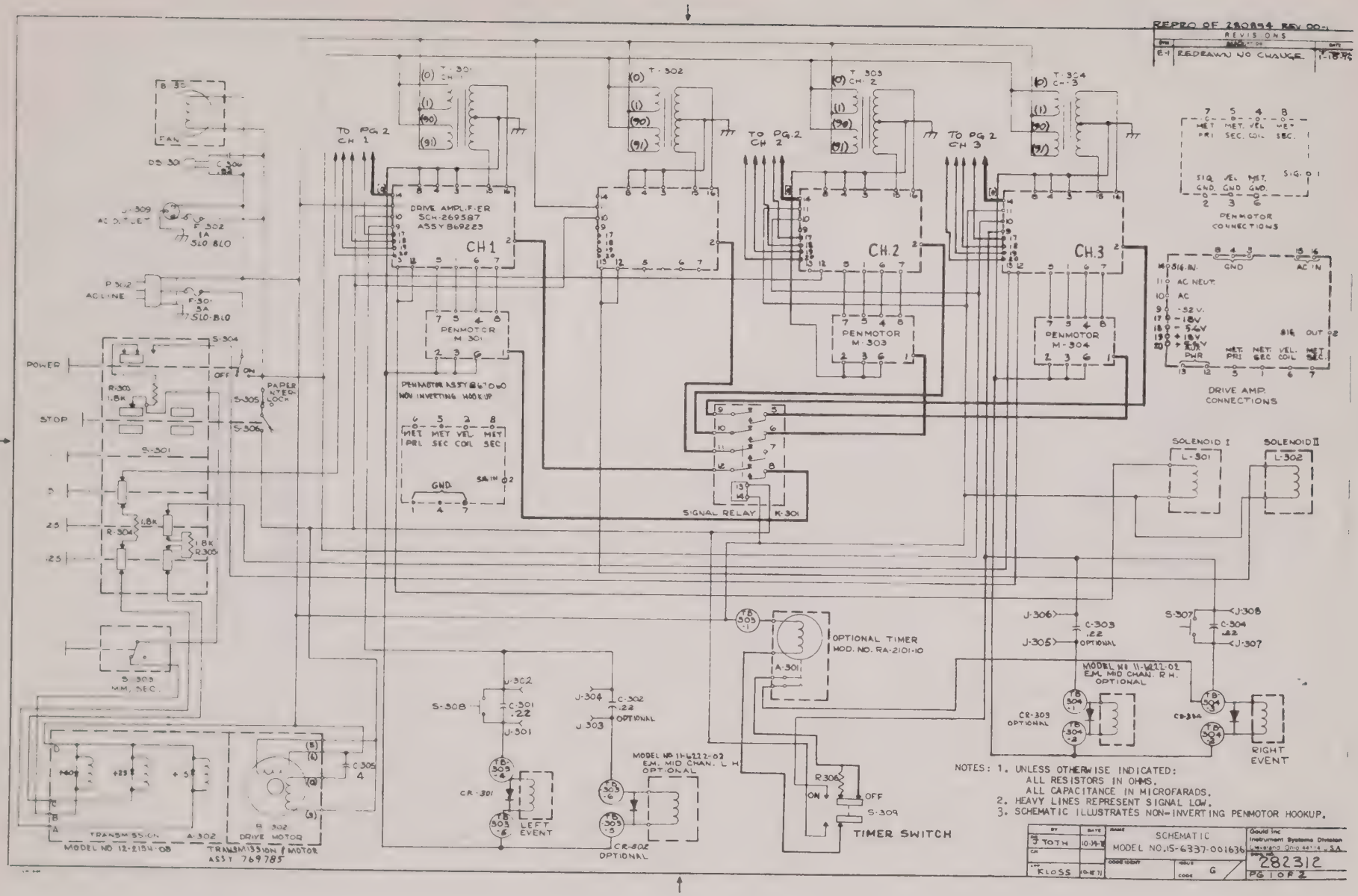
REVISIONS

SYM	DESCRIPTION	DATE	APPROVED
A-1	REDRAWN NO CHANGE (140-M 7 TOTH		



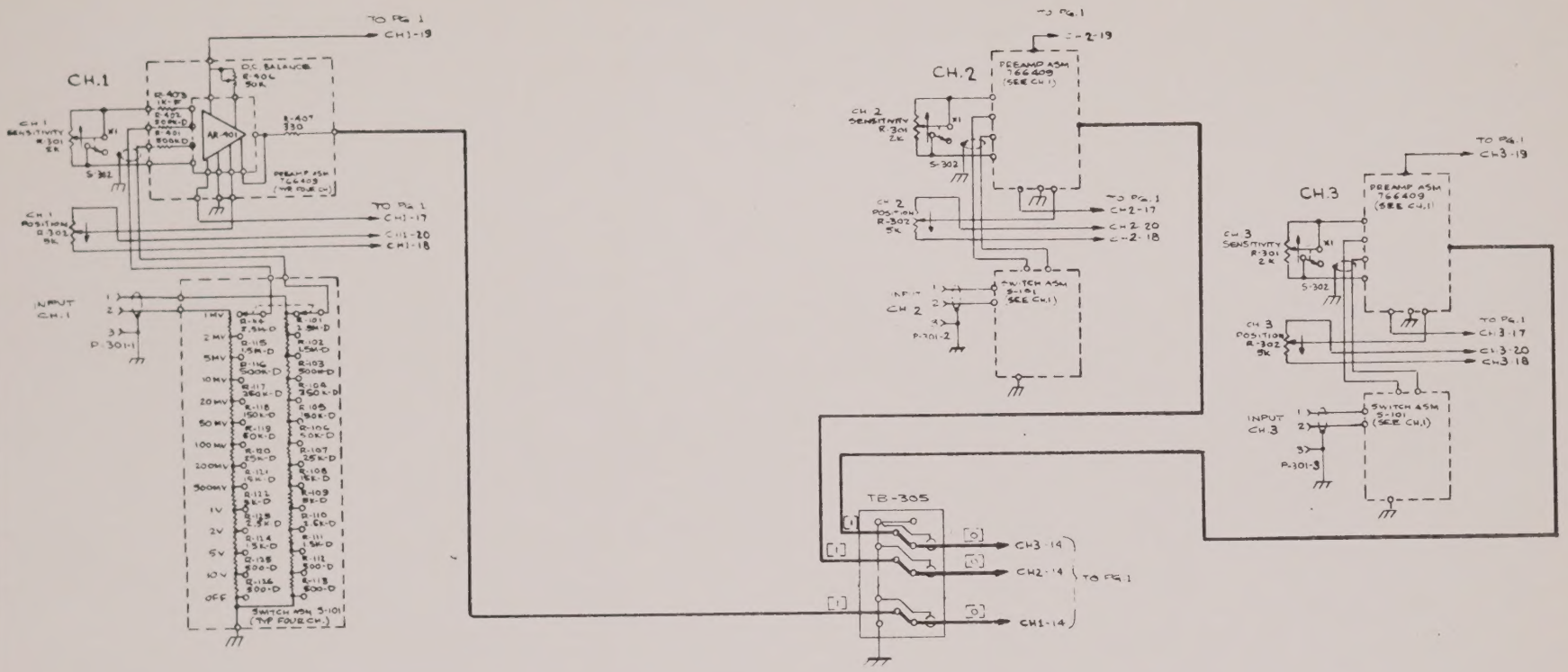
: WIRE COLORS IN EIA COLOR CODE SHOWN IN BRACKETS [ ]
OTES:

BY	DATE	NAME	SCHEMATIC	Gould Inc Instrument Systems Division Cleveland, Ohio 44114 U.S.A.
J.TOTH	9-14-71	MODEL 19-6337-101636		DWG NO 282311
K.LOSO	9-16-71	CODE IDENT 96795	SIZE G	PG 2 OF 2


REPRO OF 280834 REV 00-1
REVISIONS
E-1 REDRAWN NO CHANGE 1-18-74
TO PG 2 CH 1
TO PG 2 CH 2
TO PG 2 CH 3
T-301
T-302
T-303 CH-2
T-304 CH-3
DRIVE AMPLIFIER SCH-269587 ASSY 869223
CH1
CH.2
CH.3
PENMOTOR M-301
PENMOTOR M-303
PENMOTOR M-304
PENMOTOR CONNECTIONS
DRIVE AMP. CONNECTIONS
PENMOTOR ASSY @ 670 00 NON INVERTING HOOKUP
SIGNAL RELAY K-301
SOLENOID I L-301
SOLENOID II L-302
FAN
DB 301
C-306 .22
J-309 AC OUTLET
F 302 1A SLO BLO
P 302 AC LINE
F 301 5A SLO-BLO
POWER
STOP
S-304
S-305
S-306
PAPER METER LOCK
R-303 1.8K
S-301
R-304 1.8K
R-305 1.8K
S-303 MM, SEC.
S-308
C-301 .22
J-301
J-302
J-303
J-304
C-302 .22 OPTIONAL
TB 305 -1
OPTIONAL TIMER MOD. NO. RA-2101-10
A-301
J-306
J-305
C-303 .22 OPTIONAL
S-307
J-308
C-304 .22
J-307
MODEL NO 11-6222-02 EM. MID CHAN. R.H. OPTIONAL
CR-303 OPTIONAL
CR-304
TB 304 -1
TB 304 -2
TB 304 -3
TB 304 -4
RIGHT EVENT
MODEL NO 11-6222-02 EM. MID CHAN. L.H. OPTIONAL
TB 303 -4
CR-301
LEFT EVENT
TB 303 -6
TB 303 -5
CR-302 OPTIONAL
TB 303 -3
R-306
ON
OFF
S-309
TIMER SWITCH
C-305 .4
TRANSMISSION A-302
MODEL NO 12-2154-08
TRANSMISSION & MOTOR ASSY 769785
DRIVE MOTOR
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL RESISTORS IN OHMS.
ALL CAPACITANCE IN MICROFARADS.
2. HEAVY LINES REPRESENT SIGNAL LOW.
3. SCHEMATIC ILLUSTRATES NON-INVERTING PENMOTOR HOOKUP.
BY J TOTH 10-19-71
CH
APP KLOSS 10-19-71
SCHEMATIC
MODEL NO. IS-6337-001636
Gould Inc Instrument Systems Division
CODE IDENT
SIZE CODE G
282312
PG 1 OF 2

REPRO OF 282206 (NO REV.)

REVISIONS			
ECN	DESCRIPTION	DATE	APPROVAL
A-1	REDRAWN NO CHANGE	1-10-77	J. TOTH

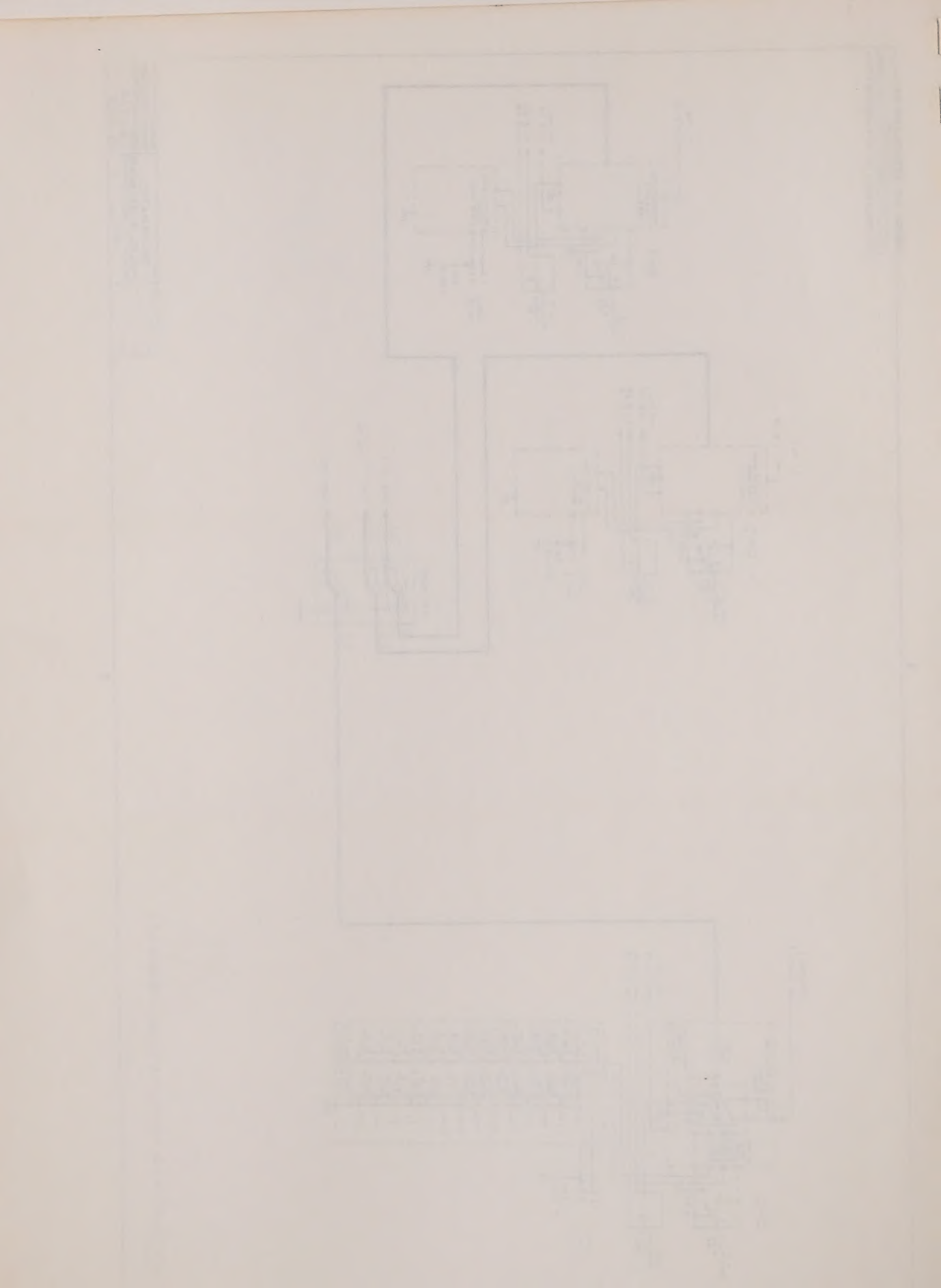


WIRE COLORS IN EIA COLOR CODE SHOWN IN BRACKETS [ ]

NOTES:

BY	DATE	NAME
DR		SCHEMATIC
CH		MODEL 15-6337-00/6336
APP		COOR IDENT 96795 ISSUE CODE G/

Gould Inc.
Instrument Systems Division
Cleveland Ohio 44114 U.S.A.
DWG NO
282312
PG 2 OF 2



MP MASTER
MA34597

Gould Inc., Instrument Systems Division
3631 Perkins Avenue, Cleveland, Ohio 44114
Telephone (216) 361-3315

GOULD